CAN THE AIR COMBAT ELEMENT OF THE MARINE AIR GROUND TASK FORCE SUCCESSFULLY CONDUCT OPERATIONAL MANEUVER FROM THE SEA IN THE TWENTY-FIRST CENTURY?

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

CAN THE AIR COMBAT ELEMENT OF THE MARINE AIR GROUND TASK FORCE SUCCESSFULLY CONDUCT OPERATIONAL MANEUVER FROM THE SEA IN THE 21st CENTURY? by LCDR Kenneth R. Becker, USN, 89 pages.

Operational Maneuver from the Sea (OMFTS) is a capstone concept that has the flexibility and diversity to meet all operational concepts in Joint Vision 2020. Under the OMFTS concept, a Naval Expeditionary Force can rapidly react to a crisis from a virtually undetectable position over the horizon, establish maritime superiority, conduct precision engagement with focused logistics and, due to the maneuverability of the naval forces, enhance its full dimensional protection. The Air Combat Element (ACE) will play a vital role in the accomplishment of the OMFTS concept. However, with the rapid rate of technological advances and the current and proposed Naval and Marine Corps aviation platforms designed to meet the OMFTS concept, is aviation able to become the integral maneuver element to successfully accomplish the four operational concepts that are embedded in Joint Vision 2020 and OMFTS? Is there a shortfall between the current and projected employment of aviation assets and the swift accomplishment of OMFTS objectives? If the MV-22 and JSF are integrated into the ACE, it is a fact that the MAGTF will be able to successfully conduct OMFTS. However, if these platforms are cancelled, the implementation of the OMFTS concept risks becoming fiction.

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ABBREVIATIONS

A/A	Air-to-Air
AAW	Antiair Warfare
ACE	Air Combat Element
A/G	Air-to-Ground
AOA	Amphibious Operations Area
ARBS	Angle-Rate Bombing System
ARG	Amphibious Ready Group
ATARS	Advanced Tactical Air Reconnaissance System
ATHS	Airborne Target Handoff System
CAS	Close Air Support
CE	Command Element
CMC	Commandant of the Marine Corps
COTS	Commercial off the Shelf
CSSE	Combat Service Support Element
DA	Day Attack
DAS	Deep Air Support
DEW	Directed Energy Weapon
DCU	Dynamic Component Upgrade
DMU	Digital Mapping Unit
DOD	Department of Defense
EA	Electronic Attack

EDATF	Emergency Defense of the Amphibious Task Force
EP	Electronic Protection
ES	Electronic Support
EW	Electronic Warfare
FAC	Forward Air Controller
FAS	Federation of American Scientists
FBW	Fly-by-Wire
FMF	Fleet Marine Force
FTP	Fleet Training Publication
GCE	Ground Combat Element
GPS	Global-Positioning System
HARM	High speed Antiradiation Missile
HMH	Marine Heavy Helicopter Squadron
HMLA	Marine Light/Attack Helicopter Squadron
HMM	Marine Medium Helicopter Squadron
HOTAS	Hands-On Throttle and Stick
HUD	Heads-up Display
IHMDSS	Integrated Helmet Mounted Display and Sighting System
JAST	Joint Advanced Strike Technology
JDAM	Joint Direct Attack Munitions
JSF	Joint Strike Fighter
KPP	Key Performance Parameters
LERX	Leading Edge Root Extensions

LIDS	Lift Improvement Devices
LRIP	Low Rate Initial Production
MAGTF	Marine Air-Ground Task Force
MCDP	Marine Corps Doctrinal Publication
MCS	Marine Corps School
MCWP	Marine Corps Warfighting Publication
MTW	Major Theater War
NA	Night Attack
NAVFLIR	Navigation Forward Looking Infrared
NM	Nautical Mile
NTS	Night Targeting System
NVG	Night Vision Goggles
OAS	Offensive Air Support
OMFTS	Operational Maneuver from the Sea
OSCAR	Open Systems-Common Architecture
OTH	Over the Horizon
SEAD	Suppression of Enemy Air Defense
SHP	Shaft Horsepower
SLAM	Standoff Land Attack Missile
SLEP	Service Life Extension Program
STOM	Ship to Objective Maneuver
STOVL	Short Takeoff/Vertical Landing
TERPES	Tactical Electronic Processing and Evaluation System

TJS	Tactical Jamming System
TRAP	Tactical Recovery of Aircraft and Personnel
VMA	Marine Attack Squadron
VMAQ	Marine Tactical Electronic Squadron
VMFA	Marine Fighter Attack Squadron
VMFA(AW)	Marine All-Weather Fighter Attack Squadron
VMGR	Marine Aerial Refueler Transport Squadron
V/STOL	Vertical Short Takeoff and Landing
WMD	Weapons of Mass Destruction

ILLUSTRATIONS

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CHAPTER 1

AMPHIBIOUS WARFARE, GLOBAL SHIFT, AND JOINT VISION 2020

The current National Security Strategy outlines a broad approach to enhance America's security, bolster prosperity, and promote democracy through active engagement abroad in partnership with allies and friends. The National Military Strategy is the strategic guidance for the military to shape, respond, and prepare for in implementing the National Security Strategy.[1] With an uncertain future and an almost overwhelming rapid advance of technology combined with a lull in peer military competitors, the military today is facing a strategic inflection point and a strategic pause. A strategic inflection point is "a time in the life of a business when its fundamentals are about to change. They are full-scale changes in the way business is conducted, so that simply adopting new technology or fighting the competition as you used to may be insufficient."[2] Strategic pause can be defined as a period when a military will not be significantly challenged by an oppositional force. The Navy Strategic Planning Guidance assumes that no peer competitor on a global scale will arise prior to 2020. This gives the military an ideal timeframe in which to pursue technological advancements and redefine its doctrine, tactics, techniques, and procedures to face the uncertainty of warfare in the twenty first century.

The uncertainty of warfare in the twenty first century will be characterized by its unpredictability, volatility, and diversity. Operations may range from humanitarian and disaster relief operations to a Major Theater War (MTW). Adversaries may employ various weapons from the very primitive to highly sophisticated. As technology

continues to advance, the reaction time in which to defend against these threats has been drastically reduced. Joint Vision 2020 provides a vision for the services to develop and utilize their inherent capabilities into the twenty first century to address the strategic inflection point. Joint Vision 2020 stresses four important operational concepts: dominant maneuver, precision engagement, focused logistics, and full dimensional protection, all supported by informational superiority across the spectrum. In order to counter these threats, the four operational concepts of Joint Vision 2020 must be fully integrated in all services, especially when developing and implementing the Marine Corps Operational Maneuver From the Sea (OMFTS) concept.

Each of the services is incorporating the features of Joint Vision 2020. The Army is developing Force XXI to ensure that it can conduct decisive, sustained combat operations on land. The Air Force conceived Global Reach, which will fulfill its assigned roles and functions of strategic air and missile warfare and air transport. The Navy published Forward . . . From the Sea, which will maintain and operate open sea lines of communication to provide strategic sealift and with the Marine Corps to project power ashore. The Marine Corps is developing the concept of OMFTS that will enhance the role of fielding expeditionary forces for rapid response to multiple contingencies in an uncertain future.[3] This capstone concept is at the top of a pyramid for twelve supporting concepts. These twelve supporting concepts are Ship To Objective Maneuver, Maritime Prepositioning Force 2010, MAGTF in Sustained Operations Ashore, Beyond C2, Advanced Expeditionary Fire Support, Future Military Operations on Urbanized Terrain, Antiarmor Operations, Information Operations, Future Naval Mine Countermeasures in

Littoral Power Projection, Sea Based Logistics, a Joint Concept For Non-Lethal Weapons, and MAGTF operations in support of OMFTS.

The Marine Corps capstone concept of OMFTS has the flexibility and diversity to meet all operational concepts in Joint Vision 2020. Under the OMFTS concept, a Naval expeditionary force can rapidly react to a crisis from a virtually undetectable position over the horizon, establish maritime superiority, conduct precision engagement with focused logistics and, due to the maneuverability of the naval forces, enhance its full dimensional protection. However, with the rapid rate of technological advances and the current and proposed Naval and Marine Corps aviation platforms designed to meet the OMFTS concept, is aviation able to become the integral maneuver element to successfully accomplish the four operational concepts that are embedded in Joint Vision 2020 and OMFTS? Is there a shortfall between the current and projected employment of aviation assets and the swift accomplishment of OMFTS objectives? OMFTS and its supporting concepts will propel the Marine Corps well into the twenty first century; however, this thesis will only focus on aviation related OMFTS issues.

In order to address the questions mentioned above, this chapter will define the OMFTS concept, its evolutionary development, the doctrinal shift from global to regional challenges, and the relevance of OMFTS to the four operational concepts laid out in Joint Vision 2020. Chapter Two will discuss the six functions of Marine Aviation, the Air Combat Element (ACE) component of the Marine Air Ground Task Force (MAGTF) and its associated aviation platforms in support of the OMFTS concept. Chapter 3 will identify criteria to evaluate the ability of the ACE to successfully accomplish the OMFTS concept. An analysis of current and projected platforms will be discussed in chapter 4.

Finally, chapter 5 will conclude this thesis and list recommendations for follow on research.

Before defining the OMFTS concept it is important to understand its evolutionary development. The evolutionary development of any concept is a result of political, economic, and social consequences. These consequences are derived from lessons learned from previous conflicts. For example, World War I was a war of attrition, which produced astounding casualties by way of frontal assaults and trench warfare. The responses to the War's ineffective tactics were the concepts of mechanized combined arms, exploitation tactics, strategic bombing, carrier operations, amphibious, and submarine warfare.

During the interwar or peacetime environment, these new concepts evolved through research, technology, experimentation, and war gaming. However, in this environment, concepts can be refined but not evaluated. Evaluation is only derived from the success or failure in conflict. Hans von Seeckt sums up best the evolutionary development of a concept: "short concise studies on the newly gained experiences of the war and consider the following points: What situations arose in the war that had not been considered before? How effective were our prewar views in dealing with the above situations? What new guidelines have been developed from the use of new weaponry in the war? Which new problems put forward by the war have not yet found a solution?"[4] What is described in the following pages is how the Marine Corps initially conducted short, concise studies, experimented with new technology, conducted fleet exercises and ultimately used conflict as a validating measure. This is important because it looks at the systematic way the Marine Corps arrived at the OMFTS concept today.

The evolution of amphibious operations and the expeditionary role of the Marine Corps were realized with the landings at Vera Cruz in Mexico in April 1914, Haiti in 1915, Santo Domingo in 1916, and France in 1917. Marine Corps aviation was in its infancy during this era and did not support ground combat troops. Major Alfred A. Cunningham, the first marine aviator and fifth naval aviator noted, "The only excuse for aviation in any service is its usefulness in assisting troops on the ground."[5] This statement would later come to fruition in World War II, where aviation developed itself as a supporting element to amphibious operations. While the Navy was making strides in the evolution of landing craft during the 1920s, Marine Corps aviators were developing the initial tactics of dive-bombing, cargo operations and close air support (CAS).

In 1927, the Joint Board of the Army and Navy recognized the history, experience, and affinity for Marine Corps in landing operations and assigned as a general function the responsibility to "provide and maintain forces for land operations in support of the fleet for the initial seizure of advanced bases and for such limited auxiliary land operations as are essential to the prosecution of the naval campaign."[6] The basis of the OMFTS concept evolved during the 1920s and 1930s when innovative Marine Corps thinkers at the Marine Corps School (MCS) studied the British Gallipoli amphibious assault and concluded that given proper planning, doctrine, and technology, amphibious assaults could be successful. During this era, aviation innovations, tactics, techniques, and procedures were being developed. In November 1932, a rotary winged machine designated the OP-1 was tested. Its value was in "inspecting small fields recommended by ground troops as landing areas, evacuating medical cases, and ferrying of important personnel."[7] The OP-1 could possibly be considered the grandfather of vertical lift in

OMFTS. However, the high gas consumption and various other issues precluded its operational value. Vertical lift utility would emerge during the Korean War.

On 9 July 1935 the first amphibious doctrine the *Tentative Landing Operations Manual* was published. This manual identified five areas of significance for amphibious operations: command relationships, naval gunfire and aerial support, ship to shore movement, tactics of securing a beachhead, and logistics. Three years later it was superceded by the *Fleet Training Publication (FTP) #167*, also known as the *Landing Operations Doctrine, U.S. Navy 1938*. It was under this doctrine that the emergence of CAS doctrine evolved and the Guadalcanal landings of 1942 were conducted.

The surprise attack on Pearl Harbor during World War II brought the United States into a protracted war with Japan. From 1942 through 1945 amphibious operations in Guadalcanal, Tarawa, the Philippines, and Okinawa had validated the *Landing Operations Doctrine*. These amphibious operations demonstrated that amphibious forces could be successful given sound Naval and Marine Corps doctrine.

After the atomic bomb detonated at Hiroshima in 1945, the Marine Corps surmised that amphibious warfare could no longer be conducted en masse.[8] Operations would have to be conducted with a dispersed naval fleet due to the perceived threat of possible atomic attack. One of the problems identified with dispersed operations was the loss of speed and combat power of an amphibious force. Marine Corps aviation developed the concept of utilizing helicopters as an integral supporting element to Marine ground forces for ship to shore movement. This would give the dispersed fleet the speed and flexibility required to counter the atomic age threat. In 1947 experimental Helicopter Squadron One (HMX-1) was established with a mission of developing doctrine for

helicopter operations in amphibious warfare. In 1948 HMX-1 participated in Operation Packard II. This joint Navy/Marine Corps exercise was the first time helicopters were utilized onboard an escort carrier (USS Palau) to conduct ship to shore movement. Packard II was the precursor to the publication of *Phib 31, Amphibious Operations – Employment of Helicopters*.

Within 2 years, the United States would again find itself in a limited war. The Korean War would validate *Phib 31* as Guadalcanal validated the *Landing Operations Doctrine*. Significant developments during the Korean War were the establishment of the first combat trained helicopter unit (VMO-6), helicopter supported medical evacuations, and troop transport. The helicopter established itself as the prime movement element to amphibious warfare, just as fixed wing aircraft had become indispensable by delivering CAS during World War II. In 1954, the concept of the Marine air-ground team was initiated, and in 1956 the USS Thetis Bay (a converted escort carrier) became the first assault helicopter transport ship (LPH-1). The Navy was starting to realize the need for ships to support helicopter ship to shore movement for future amphibious operations.

During the 1960s and early 1970s the advancements to vertical lift and envelopment were significant. The Marine Corps became experts in the use of helicopters for tactical mobility during the Vietnam War. The higher mobility of helicopters provided greater flexibility and depth on the battlefield.

The incorporation of the tactical mobility of the helicopter during the Vietnam War increased the US Marine Corps interest for a vertical short take-off landing (V/STOL) capable tactical fixed wing aircraft. In mid 1968, Lieutenant Colonel Metzko, then Head, RD&S Section, Air Weapons Systems Branch of Headquarters, US Marine

Corps requested that the Marine Corps take a look at the improved AV-8A "Harrier", which was being incorporated into the Royal Air Force.[9] The Marine Corps recognized after numerous flight test evaluations that such an aircraft could have a significant impact on existing aircraft tactics and procedures and by mid 1971 had established Marine Attack Squadron (VMA)-513 as the first AV-8A Harrier V/STOL aircraft squadron. Ironically, in 1965 General Wallace M. Greene, Jr. (Commandant of the Marine Corps (CMC)) envisioned a long range Marine Corps plan and stated "The primary amphibious assault capability of the landing force will consist of fully V/STOL mobile Marine air-ground teams, launched and supported from mission designed amphibious shipping, under all conditions of weather and visibility. This will be complemented by a surface assault capability utilizing high speed surface craft, either water or air cushion borne able to project troops, equipment, and supplies onto the beach beyond the high water line."[10] The projected employment of the MV-22 and Joint Strike Fighter (JSF) currently supports this vision.

This long-term vision of amphibious lodgments beyond the high water line would sustain itself until after the culmination of the Soviet threat in the early 1990s. It was at this time that the Navy published a white paper entitled *From the Sea*, which shifted priorities from global threats to regional challenges. Two years later, *Forward . . . From the Sea* was published. This white paper further refined the role of Naval forces in the littoral region (on or near the shore). Shortly thereafter, the Marine Corps derived and published the concept of OMFTS. This concept focused on an operational objective; used the sea as a maneuver space; generated overwhelming tempo and momentum; pitted strength against weakness; emphasized intelligence, deceptions, flexibility; and the

integration of all organic, joint, and combined assets. It was a new, innovative way of applying the original five areas of significance in amphibious operations brought out in the *Landing Operations Doctrine*.

This new concept differs slightly from the original five areas of amphibious operations. The five original areas of amphibious operations stressed attrition warfare, amphibious lodgment, and ship to shore movement with operational pauses. With today's asymmetric threat, these characteristics would breed inefficiency and an increased threat to the naval expeditionary force. The OMFTS concept strives to remove the inefficiency and decrease the threat. It accomplishes the objective by a marriage of the terms maneuver and naval warfare. Maneuver warfare is a war fighting philosophy that seeks to shatter the enemy's cohesion through a variety of rapid, focused, and unexpected actions, which create a turbulent, and rapidly deteriorating situation with which the enemy cannot cope.[11] Naval warfare, however, is not a term that can be found in any military dictionary but it can be deduced from the work of Sir Julian Corbett. Corbett wrote: "Command of the sea, therefore, means nothing but control of maritime communications, whether for commercial or military purposes; the object of naval warfare is the control of communications, and not, as in land warfare, the conquest of territory."[12] Therefore, Naval warfare is the ability to achieve one's own sea movement and deny it to the enemy; to directly or indirectly secure the command of the sea or to prevent the enemy from securing it; and to project power ashore or to re-supply overseas forces.[13]

OMFTS separates itself from the *Landing Operations Doctrine* by the use of the sea as an operational maneuver space. The sea is an area of friendly movement, a barrier

to the enemy, and offers a unique degree of flexibility and operational advantage.[14] The heart of OMFTS is the maneuver of naval forces at the operational level, a bold bid for victory that aims at exploiting a significant weakness in order to deal a decisive blow.[15] Under this OMFTS concept, the ACE will play a greater role in operations in the twenty first century.

As mentioned earlier, Navy forces have shifted from global to regional challenges. It is likely that these regional challenges will occur in the littoral region. While representing a relatively small portion of the world's surface, littorals provide homes to over three-quarters of the world's population, locations for over 80 percent of the world's capital cities, and nearly all of the marketplaces for international trade.[16] If the only acceptable avenue of approach is from the sea, Naval expeditionary forces must have the capability of rapidly projecting power from the sea and air, fostering the ability to be self-sufficient and remain on station for an extended period of time, and be unencumbered by foreign government restrictions on transit or over flight issues. This Naval expeditionary force is a force that is most suited to Joint Vision 2020 and its four operational concepts: dominant maneuver, precision engagement, focused logistics, and full dimensional protection.

These four operational concepts of Joint Vision 2020 are the framework for OMFTS. OMFTS is a concept that is now being tested by numerous fleet exercises, much like the fleet exercises that were conducted during the 1930s for the *Tentative Landing Operations Manual*. World War II validated the *Landing Operations Doctrine* and the Korean War validated *Phib 31, Amphibious Operations – Employment of Helicopters*. A critical question now is how can the OMFTS concept be validated? More

specifically, does the ACE become the lead element of the MAGTF to successfully accomplish the operational objectives of the OMFTS concept? Is there a shortfall between current employment of aviation assets and the swift accomplishment of OMFTS objectives? Furthermore, are the current and projected aviation platforms the right choice for what is needed to support OMFTS in the twenty first century? In order to address these questions, the next chapter will define the MAGTF, the six functions of Marine Corps aviation, and the platforms of the ACE, which will develop a baseline for anticipated problems that might be inherent for the swift accomplishment of OMFTS objectives in the twenty first century.

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[1] U.S. Department of the Navy, *Navy Strategic Planning Guidance* (Washington D.C.: Department of the Navy, n.d.), 3.

[2] Charles C. Krulak, "Operational Maneuver From the Sea," *Joint Force Quarterly*, Spring 1999, 78.

[3] Ibid., 80.

[4] James S. Corum, *Hans von Seeckt and German Military Reform: The Roots of Blitzkrieg* (Lawrence, KS: University Press of Kansas 1992), 31. After World War I, German Army leaders began to analyze the lessons of that war, and created a tactical doctrine that had taken into account the change in warfare that occurred. This tactical doctrine was later identified as Blitzkrieg during the timeframe between 1939 and 1941. Hans von Seeckt is considered the founder of this doctrine. He was the German General Staff Chief from 1918 to 1920 and Army Commander from 1920 to 1926. From 1920 through 1926 he developed, reorganized, and trained the German Army in this tactical doctrine. A correlation can be drawn between this concept and the present day concept of OMFTS. Both concepts strike quickly at the enemy objective. Hans von Seeckt believed the key to victory was mobility and maneuverability.

[5] Kenneth J. Clifford, *Process and Purpose: A Developmental History of the U.S. Marine Corps 1900-1970* (Washington D.C.: History and Museums Division, Headquarters USMC 1973) 21.

[6] Ibid., 36.

[7] Ibid., 58.

[8] Ibid., 78. CMC General Alexander A. Vandegrift appointed a Special Board headed by Major General Lemuel C. Shepard, Jr., Assistant CMC and two other board members, Major General Field Harris, Director of Aviation and Brigadier General Oliver P. Smith, Commandant of the Marine Corps Schools to review the matter of amphibious operations in the atomic age. On 16 December 1946, the Special Board submitted to the CMC the findings of their study. The board stated: "The atomic bomb now prohibits the heavy concentrations of ships and landing craft heretofore used in amphibious operations. The answer lies in a wide dispersion of our attack force, a rapid concentration of our landing force by means other than small boats or amphibians and thereafter maintaining close contact with the enemy. Airborne operations by landplane transport, by parachute or by glider are not suitable for Marine Corps employment… Submarine transports will be useful but to a limited extent. The development of a combination of large flying boats and helicopters will overcome the limitations of a purely airborne method, keep the enterprise a purely naval one, and permit its rapid exploitation and support from widely dispersed and more economical surface vessels."

[9] Ibid., 112.

[10]Ibid., 113.

[11]U.S. Department of the Navy, *Marine Corps Doctrinal Publication 1, Warfighting* (Washington D.C.: United States Marine Corps, 1997), 73.

[12]Wayne P. Hughes, "Naval Warfare," *NWC Review*, Summer 1997.

[13]Eric Grove, *The Future of Sea Power*, (Annapolis, MD: Naval Institute Press 1990), 12.

[14]U.S. Department of the Navy, *The Naval Amphibious Warfare Plan* (Washington D.C.: United States Marine Corps, Expeditionary Warfare Division (N85), n.d.).

[15]U.S. Department of the Navy, *Operational Maneuver From the Sea* (Washington D.C.: United States Marine Corps, 4 January 1996).

[16]Ibid., 3.

CHAPTER 2
THE FUNCTIONS OF MARINE AVIATION AND THEIR PLATFORMS

> In brief, the whole future of warfare appears to me to lie in the employment of mobile armies, relatively small but of high quality, and rendered distinctly more effective by the addition of aircraft.
>
> Gen. Hans von Seeckt, *The Roots of Blitzkrieg*

The development of the *Tentative Landing Operations Manual* in 1935 gave recognition to Marine aviation as an integral and vital supporting element in the execution of the primary mission of the Marine Corps. The fleet exercises of the 1930s laid the groundwork for the refinement of an emerging concept--the Marine air-ground team. Shortly after the completion of World War II, the jet aircraft brought about an era of range extensions, a compression of speed and time factors, routine all weather operations, and greatly improved weapons delivery accuracy. Concurrently, the technological advancements of the helicopter were giving a new meaning to assault support. In the 1950s, the Korean War saw Marine ground forces seeking the direct support of fixed-wing CAS. In the 1960s and early 1970s, the Vietnam War refined helicopter operations, and in the late 1970s the Marine Corps developed the MAGTF structure, as it is known today.

This MAGTF structure is comprised of four core elements: a Command Element (CE), a Ground Combat Element (GCE), an Air Combat Element (ACE), and a Combat Service Support Element (CSSE). Speed, mobility, and flexibility are the cornerstone requirements for successful MAGTF operations in an uncertain environment with increased threat capabilities. The ability of the ACE to fulfill these requirements, operate

from large and small naval platforms, austere positions ashore, and established airfields allows the MAGTF to focus and magnify combat power. The ultimate objective of the ACE is the swift accomplishment of the MAGTF mission.

Throughout this evolutionary period, Marine aviation (i.e. ACE) has developed six functional areas unique unto itself in support of the MAGTF mission. These six functional areas are: offensive air support (OAS), antiair warfare (AAW), assault support, air reconnaissance, electronic warfare (EW), and control of aircraft and missiles. The *Marine Corps Warfighting Publication (MCWP) 3.2 Aviation Operations* is the governing publication that briefly defines each function. These functions are further discussed in depth in each of their respective *MCWPs.* However, EW is the only function that does not have its own *MCWP*. EW is discussed in *MCWP 3.22 AAW and 3.22.2 Suppression of Enemy Air Defense (SEAD)*.

The first function, OAS, is those air operations conducted against enemy installations, facilities, and personnel to directly assist in the attainment of MAGTF objectives by the destruction of enemy resources or the isolation of his military force.[1] OAS is divided into two separate categories, CAS and deep air support (DAS). CAS focuses on the engagement of hostile targets within close proximity of ground troops while DAS focuses on targets far removed from this proximity.

AAW is the second function of Marine aviation. AAW is that action required to destroy or reduce to an acceptable level the enemy air and missile threat.[2] AAW's primary objective is air superiority and is divided into offensive and defensive actions. AAW offensive actions are an attempt to attack the enemy air or air defense systems before they have launched or pose a threat. AAW defensive actions are classified as

either active or passive. An active air defense is a direct defensive action taken to destroy, nullify, or reduce the effectiveness of hostile air and missile threats against friendly forces while a passive air defense includes all other measures such as concealment, deception, dispersion, and mobility.[3]

The third and fourth functions are assault support and air reconnaissance. Assault support is the use of aircraft to provide tactical mobility and logistic support for the MAGTF, while air reconnaissance is the acquisition of intelligence information by employing visual observation and/or sensors in air vehicles.[4] Air reconnaissance can be visual, multisensory, or electronic.

The fifth function is EW. EW is any military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy.[5] The three categories of EW are electronic attack (EA), electronic protection (EP), and electronic support (ES). EA utilizes specific weapons to degrade, neutralize, or destroy enemy combat capability. EP seeks to prevent the enemy from neutralizing or destroying a friendly force combat capability, and ES utilizes sensors to perform threat recognition and intention.

The final function is control of aircraft and missiles. The control of aircraft and missiles integrates the other five functions of Marine aviation by providing the commander with the ability to exercise command and control over Marine aviation assets.[6] The ACE's ability to utilize these six functions to conduct maneuver at the time and place of the commander's choosing, conduct close and deep fires, collect intelligence, provide just in time logistics, and provide a layered defense is integral not only to the MAGTF but the naval expeditionary force as well.

Recently, the Marine Corps published a concept paper *MAGTF Aviation and Operational Maneuver From the Sea* describing future capabilities of MAGTF aviation in the twenty first century in support of the OMFTS concept. It described the current systematic process for reacting to a threat in a theater of operations: alert forward deployed forces; initiate command, control, and surveillance; define and dominate the amphibious operations area (AOA); conduct an area preparation; and prepare for power projection ashore. In this process, OMFTS consists of amphibious ship movement and maneuver, fire support, ship to objective maneuver (STOM), and logistics sustainment. The naval expeditionary force will operate over the horizon (OTH) from sea bases stationed 25 or more nautical miles (NM) from shore with an operating range capable of striking inland in excess of 100 NM. The ability to perform these capabilities, as envisioned by OMFTS, is divided among a mix of aviation platforms currently and projected to be in the Marine Corps inventory as represented in table 1.

This table is a summary of the Marine aviation functions and their corresponding platforms. All six functions play a vital role in the OMFTS concept; however, only AAW, assault support, OAS, EW, and air reconnaissance are specifically related to platform capabilities. The function of control of aircraft and missiles is a tool utilized by the ACE Commander to plan, direct, and control these platforms in support of the accomplishment of the MAGTF mission. Therefore, only the five previously mentioned functions of Marine aviation will be discussed in this thesis. Furthermore, this table will utilize the primary and secondary functions of the platforms as a basis for the methodology to be discusses in chapter 3. In order to understand the possible challenges that Marine Corps aviation might encounter in accomplishing the concept of

Table 1. P (primary function), S (support function), S/D (self-defense), *JSF will start to replace in 2008, **MV-22 will replace in 2003, Source: MCWP 3.2 Aviation Operations

Type of Aviation Unit	AAW	Assault Support	OAS	EW	Air Reconnaissance	Control of A/C & Missiles
VMFA* (F/A-18 A/C)	P	ESCORT	P	S	P	
VMFA (AW)* (F/A-18 D)	P	ESCORT	P	S	P	
VMA* (AV-8B)	P	ESCORT	P	S	P	
VMAQ (EA-6B)	S	S	S	P	P	
VMGR (KC-130)	S	P	S	S	S	
VMM (MV-22)	S/D	P	S	S	S	
HMLA (ATTACK) (AH-1W)	P	P	P	S	P	
HMLA (UTILITY) (UH-1N)	S/D	P	S	S	S	
HMH (CH-53E)	S/D	P	S	S	S	
HMM** (CH-46E)	S/D	P	S	S	S	
MACG						P

OMFTS, it is important to set the stage and describe these platforms before identifying any critical shortfalls.

The Marine Fighter Attack Squadron (VMFA) intercepts and destroys enemy aircraft under all weather conditions and attacks and destroys surface targets.[7] The Marine Corps FA-18A/C is a carrier borne and land-based attack/fighter, which replaced the aging F-4s as attack aircraft. In 1983, the first active FA-18A squadron was VMFA-314. FA-18Cs entered service from FY86 onwards with the additional capability of night attack. Additional VMFA tasks include providing escort to friendly aircraft, day and night CAS, an ability to conduct extended range operations via aerial refueling, and the

capability to conduct SEAD operations.

The Marine All-Weather Fighter Attack Squadron (VMFA (AW)) attacks and destroys surface targets under adverse weather conditions during both day and night operations; conducts multisensor imagery reconnaissance; provides supporting arms coordination; and intercepts and destroys enemy aircraft under all types of weather conditions.[8] Production of F/A-18D aircraft began in 1986, with night attack procurement in 1988. The Marine Corps has replaced six squadrons of A-6Es, OA-4s, and RF-4Bs in attack, reconnaissance, and forward air controller modes.[9] Additional VMFA (AW) tasks are identical to VMFA with the inclusion of armed reconnaissance, radar search and attack, and air interdiction.

The Marine Attack Squadron (VMA) attacks and destroys surface targets under day and night visual meteorological conditions and also provides helicopter escort.[10] Deliveries of AV-8Bs began in 1984 with VMA-331 as the first operational squadron in 1985. Current versions in the Marine Corps inventory are the AV-8B Harrier II day and night attack aircraft, and the Harrier II Plus radar equipped night attack aircraft. Additional VMA tasks include CAS, air defense operations, extended operations via aerial refueling, the capability to operate from remote landing sites, and the ability to conduct armed escort missions in support of assault operations.

The Marine Tactical Electronic Squadron (VMAQ) conducts airborne EW in support of Fleet Marine Force (FMF) operations to meet the EW and air reconnaissance functions of Marine aviation.[11] The EA-6B is the Department of Defense's (DOD) only asset that can provide lethal and non-lethal suppression of enemy command and control air defenses.

The Marine Aerial Refueler Transport Squadron (VMGR) provides aerial refueling service in support of the MAGTF. Using the KC-130, it also provides air transport of personnel, equipment, and supplies.[12]

The Marine Light/Attack Helicopter Squadron (HMLA) provides combat utility helicopter support, attack helicopter fire support, and fire support coordination during amphibious operations and subsequent operations ashore.[13] The HMLA is broken down into the UH-1N Huey and AH-1W Cobra attack helicopters. Both helicopters are scheduled to be upgraded during the 2004 timeframe. This upgrade includes equipment that is common to both airframes: engines, main rotor systems and tail rotors, drive trains, hydraulics and electrical systems, and common configuration cockpits. These upgrades are designed to reduce training workloads, maintenance and logistics costs. The current plan is for the upgraded UH-1Y and AH-1Z to bridge the gap until a joint helicopter replacement can be fielded in 2020.

The Marine Heavy Helicopter Squadron (HMH) provides assault helicopter transport of heavy weapons, equipment and supplies during amphibious operations and subsequent operations ashore.[14] The existing CH-53E is planned to be the heavy-lift platform through 2025.

The Marine Medium Helicopter Squadron (HMM) provides assault transport of combat troops in the initial assault waves and follow-on stages of amphibious operations and subsequent operations ashore.[15] The CH-46E has been operational for over 30 years with numerous upgrades to prolong its service life until the MV-22B (VMM) is fully operational in the fleet.

The replacement of the CH-46E within the next five years, the development of the JSF, and the search for a common combat support platform in the 2025 timeframe support the vision of Gen. Charles C. Krulak. In 1995, Commandant Krulak provided strategic direction for the Marine Corps into the twenty first century. He assigned Marine aviation the task of "enhancing its expeditionary utility by reducing the number of type/model/series aircraft with the goal of achieving an all short takeoff/vertical landing (STOVL) aviation component."[16] Two new aviation platforms will be introduced into the operational Marine Corps inventory within the next eight years, the Joint Strike Fighter (JSF) and the MV-22B Osprey. These platforms support General Krulak's fixed and rotary wing neck down strategy that is estimated to be complete by 2015. The JSF is a multi-role; STOVL aircraft designed to replace the AV-8B and the F/A-18A/C/D aircraft. It is expected that the first operational JSF will be delivered in 2008.

The MV-22B Osprey is designated as the medium lift replacement for the aging CH-46E Sea Knight and CH-53D Sea Stallion helicopters. It is projected to be fleet operational by 2003. The MV-22B can be considered the focal point of the ACE in its ability to meet the requirements envisioned in OMFTS. The Osprey has numerous enhancements over traditional vertical lift capabilities. It can land and take-off vertically and transition to an in-flight fixed wing mode giving it double the speed capability. The combat load capacity is twice that of a CH-46E with a corresponding 2.5 times increase in combat radius. Combine these enhancements with the additional benefit of aerial refueling capability and it can easily be seen that the MV-22B is a versatile platform suitable to the OMFTS concept.

The versatility of the proposed JSF and MV-22, plus the ability of the ACE to support the OMFTS concept has many strengths. It combines the terms maneuver and naval warfare, pits strengths against weaknesses, eliminates the operational pause at the beachhead, and generates overwhelming tempo and momentum. These strengths prevent the enemy from being able to react until it is too late. But the supporting role of the ACE has left some unanswered questions. What kind of battlefield objectives will it aim at? Will the aviation platforms of the ACE be able to achieve the objectives? What is the role of subsequent operations ashore, and can the ACE support the OMFTS concept logistically? The next chapter will describe the relationship between Joint Vision 2020 and the OMFTS concept and develop criteria, which can be used to evaluate the ability of the ACE to successfully accomplish the MAGTF/OMFTS mission in the 21st century.
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[1] U.S. Department of the Navy, *Marine Corps Reference Publication (MCRP) 5-12D Marine Corps Supplement to the DOD Dictionary of Military and Associated Terms* (Washington D.C.: United States Marine Corps, July 1998).

[2] U.S. Department of Defense, *Joint Pub 1-02 DOD Dictionary of Military and Associated Terms* (Washington D.C.: Joint Staff, 23 March 1994), 33.

[3] Ibid., 39.

[4] U.S. Department of the Navy, *Marine Corps Warfighting Publication (MCWP) 3-2, Aviation Operations* (Washington D.C.: United States Marine Corps, May 2000), 3.

[5] Ibid., 2-4.

[6] Ibid., 2-5.

[7] U.S. Department of the Navy, *MCRP 5-12D Organization of Marine Corps Forces* (Washington D.C.: United States Marine Corps, 13 October 1998), 3-25.

[8] U.S. Department of the Navy, *MCWP 3-2,* 2-11.

[9] Paul Jackson, e.d., *Jane's All the World's Aircraft 1997-1998* (Alexandria, VA.: Jane's Information Group Inc.), 574.

[10]U.S. Department of the Navy, *MCWP 3-2,* 2-11.

[11]Ibid., 2-10.

[12]Ibid., 2-10.

[13]U.S. Department of the Navy, *MCRP 5-12D,* 3-30.

[14]Ibid., 3-28.

[15]Ibid., 3-29.

[16]James T. Reynolds, "The Joint Strike Fighter: The Future of Marine Fixed-Wing Attack Aircraft," *Marine Corps Gazette*, May 96, 35.

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CHAPTER 3

DEVELOPING A METHODOLOGY

The OMFTS concept is a relatively new concept designed to propel the Marine Corps well into the twenty first century. It is a concept paper that focuses on six basic tenants: an operational objective; using the sea as a maneuver space; generating overwhelming tempo and momentum; pitting strength against weakness; emphasizing intelligence, deception, and flexibility; and the integration of all organic, joint, and combined assets. These six tenants stress the need for the MAGTF to project power throughout most of the world's littoral regions. With three-quarters of the world's population, eighty percent of the world's capital cities, and nearly all of the marketplaces for international trade in proximity to the sea, the strategic shift to these regional areas lends itself to the validity of the OMFTS concept. New technologies such as the JSF and the MV-22 offer the MAGTF new options in conducting amphibious operations. OMFTS calls for improvements in the ability to rapidly move from the ship to objectives, which may be over 100 NM inland. It also identifies the need for a modernization of aviation aircraft capable of multiple missions, of operating from ships and austere bases ashore, and of landing on a wide variety of surfaces. However, what OMFTS fails to describe is where the enemy center of gravity may likely be, how to attack it, and what platforms are necessary to achieve the objectives in order for the MAGTF to be successful.

Of the four elements of the MAGTF (CE, GCE, ACE, CSSE), a greater reliance is placed on the ACE's ability to accomplish the objectives of the OMFTS concept. But

what does the OMFTS concept mean to the ACE? Is the ACE actually able to support the requirements of OMFTS well into the twenty first century? In order to answer these questions, there has to be some sort of criteria that can be used to evaluate the suitability of the ACE in the accomplishment of the OMFTS concept. Joint Vision 2020, although generalized in scope, provides four key criteria that can be useful in evaluating the ACE's ability to meet the unanswered questions of OMFTS in the twenty first century. As mentioned in chapter One, these four criteria are dominant maneuver, precision engagement, focused logistics, and full dimensional protection.

It is important to define these four criteria and their relevance to OMFTS. First, dominant maneuver can be explained as once a Naval expeditionary force locates, identifies, and tracks targets it must maneuver to possess a situational advantage in order to conduct offensive or defensive operations. Operational security and deception by way of over the horizon (OTH) maneuvers will assist in the ability to conduct operations by increasing the "fog of war" over the enemy's capability to react. Also inherent in this force is the ability to achieve land, air, and maritime superiority. It is at this point that operational maneuver is linked to the strategic or operational objective. Dominant maneuver, therefore, is the ability to gain control of the entire spectrum of the battle space.

The second criterion within Joint Vision 2020 is precision engagement. This includes bombs, rockets, missiles, artillery, and non-lethal means that are delivered to operational depths. It also encompasses placement of troops ashore, bypassing the beachhead as delineated in the OMFTS concept. Other Joint Vision 2020 criteria are

supported by precision engagement. It can facilitate dominant maneuver, underwrite full dimensional protection, and provide cover for focused logistics.[1]

Full dimensional protection is the third criterion within Joint Vision 2020 and is the conservation of the operational fighting force. It may be a passive (deception, opsec, etc.) or an active defense (e.g. Emergency Defense of the Amphibious Task Force (EDATF)). It requires the ability to conduct reconnaissance and gather intelligence on enemy strengths and weaknesses, and identifies threats that the naval expeditionary force may be exposed to. Although the sea provides a preponderance of full dimensional protection, dominant maneuver and precision engagement both contribute to the protection of the force.

Finally, focused logistics is the fourth criterion and is achieved by the fusion of information, logistics, and transportation technologies to do the following: provide rapid crisis response, track and shift assets even while enroute, and deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical levels of operation.[2] Without focused logistics the OMFTS concept cannot be accomplished.

When preparing for any operation utilizing traditional amphibious approaches or the innovative OMFTS concept, planners must consider the functional area of Marine aviation, not the specific platform when analyzing the requirements of accomplishing the objective. In order to maximize the OMFTS concept the ACE must address five critical capabilities: flexibility, maneuverability, lethality, expeditionary, and logistics. Additionally, when considering the ACE role in the OMFTS concept, four questions need to be asked. Does the ACE need a specific capability? If so, does the ACE have that

capability? If the ACE has the capability, is it enough? If the ACE does not have the capability, can another organization provide it?

In order for methodology to be sound, capabilities and/or criteria must be derived from credible sources. The capabilities of flexibility, maneuverability, lethality, expeditionary, and logistics have been formulated from *Marine Corps Doctrinal Publication (MCDP) 1-3 Tactics, MCWP 3.2 Aviation Operations,* and its subsets of Marine Aviation functional *MCWPs*, mentioned in chapter 2.

Capability is a broad term, but this thesis will define each capability as they relate to the OMFTS concept. The first capability, flexibility, is defined as a capacity for ready adaptation to various purposes or conditions.[3] In the OMFTS concept these various purposes may vary across the spectrum of functional areas. Flexibility might be the ability to conduct multiple missions in one platform, such as in the F/A-18, AV-8B, or the AH-1W; or the ability to change its logistical carrying capacity other platforms, such as the KC-130, CH-46E, or CH-53E.

By definition, maneuverability is the quality of an aircraft to respond readily to controls and to changes in the flying attitude. An aircraft is maneuverable when it readily and accurately does what the pilot wants it to do.[4] For the OMFTS concept, maneuverability might address range and speed in one platform, or the ability to conduct high stress maneuvers in another.

Lethality is the condition or quality of being lethal; the ability to cause death; deadliness.[5] In the OMFTS concept, lethality addresses firepower. Some aviation functions rely heavily on lethality, such as AAW, EW, and OAS; other functions have a limited lethality capability, such as assault support.

The fourth capability is an expeditionary capability. By definition, it involves the deployment of military forces to the scene of a crisis or conflict and their requisite support some significant distance from their home bases. It may range greatly in scope, from full-scale combat to non-combat missions. It implies a temporary duration in austere conditions with an intent to withdraw.[6] In this thesis the definition of an expeditionary capability in relation to the OMFTS concept involves the ability to operate in austere conditions without the reliance of a traditional ground prepared surface.

The last capability to define is logistics. Logistics is the science of planning and carrying out the movement and maintenance of forces. Logistics provides the resources of combat power, positions those resources on the battlefield, and sustains them throughout the execution of operations. It encompasses a wide range of actions and the relationships among those actions, as well as the resources that make those actions possible.[7] For the purposes of this thesis, the logistics capability will vary for the functions of Marine aviation. For all functions, logistics will be defined by operational sustainability and maintenance supportability. For the function of assault support, additional requirements of logistics re-supply and troop transport will be added.

When looking at the five critical capabilities and asking the four questions mentioned previously, a link can be drawn to the four criteria mentioned in Joint Vision 2020 and the five functions of Marine aviation, as shown in table 2. Dominant maneuver

Table 2. OMFTS Relationship to Joint Vision 2020.

can be linked to two of the six functions of Marine aviation: assault support and AAW. Dominant maneuver is the ability to achieve and maintain land, air, and maritime superiority. The Marine aviation function of assault support gives the ground combat element commander the ability to enhance his land superiority by utilizing various aviation platforms to assist in the rapid movement of troops to the time and place of his choosing, for either offensive or defensive operations. AAW is linked to dominant maneuver by the action required of aviation platforms to reduce to an acceptable level the enemy air and missile threat. This will achieve air superiority and enhance the ability of the GCE commander to achieve land superiority. Maritime superiority is exterior to the MAGTF and is the ability of naval forces to conduct sea maneuvers to control sea space OTH. Maritime superiority will not be addressed in this thesis.

Precision engagement can be linked to OAS and assault support. In regards to OAS, various platforms of the ACE give the MAGTF the ability to project firepower to shape events needed for successful land operations. OAS (i.e. precision engagement) can be a precursor to dominant maneuver. Assault support is one of the few functions of Marine aviation that can be linked not only to dominant maneuver as described above, but also to precision engagement as well. The OMFTS concept stresses the placement of

FUNCTIONS OF MARINE AVIATION	DOMINANT MANEUVER	PRECISION ENGAGEMENT	FULL DIMENSIONAL PROTECTION	FOCUSED LOGISTICS
ASSAULT SUPPORT	PRIMARY	PRIMARY		PRIMARY
AAW	PRIMARY		PRIMARY	
AIR RECONNAISSANCE			PRIMARY	
EW			PRIMARY	
OAS		PRIMARY		

troops at the objective, bypassing the beachhead, as normally seen in traditional amphibious operations. It is a precursor to attaining land superiority. For this reason, the function of assault support plays a vital role in precision engagement.

Full dimensional protection can be linked to AAW, EW, and air reconnaissance. Although the preponderance of full dimensional protection falls on OTH operations and utilizes the sea as a barrier to the enemy, AAW, EW, and air reconnaissance fill the gaps where the abilities of the naval forces fall short. AAW has an interrelationship between dominant maneuver and full dimensional protection. Its mission is two-fold, air superiority and force protection. EW and air reconnaissance utilize aviation platforms to detect, identify, and/or neutralize targets before becoming a threat to the naval expeditionary force, thus giving the naval expeditionary force the protection that is needed.

Focused logistics can be linked to assault support. Once forces have been established at the objective, the ability of aviation platforms to support the troops plays an important role in the continued success of the MAGTF mission. The success of any mission is only as good as the ability to sustain it.

The methodology to evaluate the ability of the ACE to accomplish the OMFTS concept within the twenty first century can be called a “capabilities, functions, and criteria” analysis. The basic framework of this analysis, as depicted in figure 1, is the platforms of the ACE. The five capabilities of flexibility, maneuverability, lethality, expeditionary, and logistics are applied to these platforms. The ability of these platforms to meet the capabilities is paramount to the OMFTS concept. These platforms must be able to adjust to varying circumstances at a tempo the enemy cannot match. They need to

be able to range farther and operate in austere conditions. The expeditionary capability serves to disperse the enemy. For example, the enemy must try to cover all avenues of approach vice just airfields and prepared surfaces. Logistically, these platforms must have maintenance reliability and in some instances, be able to provide resources to sustain the force at the objective. Once that step has been completed, this thesis will then take the functional areas and apply them to their respective platforms. This serves the purpose of identifying whether or not a functional area is deficient in being able to support the OMFTS concept. Once that analysis has been completed, the functional areas are then analyzed with their respective Joint Vision 2020 criterion. This last part of the analysis serves two purposes: it determines whether or not any of the Joint Vision 2020 criterion are more significant in the OMFTS concept, and if the ACE can successfully accomplish the OMFTS concept in the twenty first century.

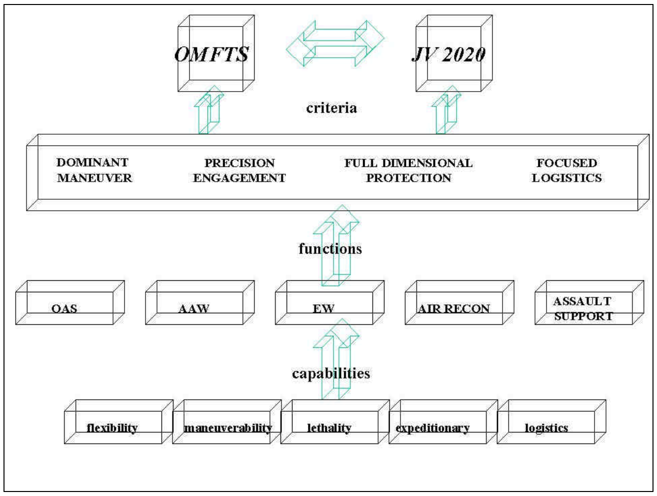

Figure 1. Capabilities, Functions and Criteria Analysis

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[1] Roger W. Barnett, “Grasping 2010 with Naval Forces,” *Joint Forces Quarterly*, Autumn/Winter 1997-98, 25-31.

[2] F. G. Hoffman, “Joint Vision 2010, A Marine Perspective,” *Joint Force Quarterly*, Autumn/Winter 1997-98, 32-38.

[3] J. A. Simpson and E. S. C. Weiner, *The Oxford English Dictionary V* (Oxford, England: Clarendon Press 1981), 481.

[4] Bill Gunston, *Jane’s Aviation Dictionary* (Alexandria, VA.: Jane’s Information Group, 1988), 255.

[5] Simpson and Weiner, 345.

[6] U.S. Department of the Navy, *Marine Corps Doctrinal Publication (MCDP) 3, Expeditionary Operations* (Washington D.C.: United States Marine Corps, 16 April 1998).

[7] U.S. Department of the Navy, Marine Corps Doctrinal Publication (MCDP) 4, Logistics (Washington D.C.: United States Marine Corps, February 1997).

CHAPTER 4

AN ANALYSIS OF THE ACE

> A General in all of his projects should not think so much about what he wishes to do as what his enemy will do; that he should never underestimate this enemy, but he should put himself in his place to appreciate difficulties and hindrances the enemy could interpose; that his plans will be deranged at the slightest event if he has not foreseen everything and if he has not devised means with which to surmount the obstacles.
>
> Frederick the Great, *Military and Naval Quotations*

Although Frederick the Great had not prophesied or understood the coming age of aviation in the twentieth century, it can be related to today's environment that if any service has not devised means with which to overcome obstacles, no conflict can or will be successful. With the uncertainty of warfare and increasing asymmetric threats emerging today, it is imperative that the services reevaluate their capabilities. With the developing OMFTS concept the Marine Corps has to take a step back and evaluate the ability of the MAGTF, and as this chapter will describe, the suitability of the ACE to accomplish the MAGTF/OMFTS mission in the twenty first century.

The following "capabilities, functions, and criteria" analysis has been developed to evaluate the ability of the ACE to accomplish the mission of OMFTS in the 21st century. There are numerous interrelationships between the functions of Marine aviation and the four criteria of Joint Vision 2020. Some functions can be used to analyze more than one criterion. This chapter will be divided into two sections: current operational platforms, and projected aviation platforms. Both sections will utilize the methodology developed in chapter 3 to analyze the capabilities of the platforms in relation to the four criteria of Joint Vision 2020.

Most of the aviation platform data to be analyzed in this chapter has been collected from various sources. A preponderance of information has been drawn from authoritative Internet sites. The reason for the reliance on the Internet is that most open source, "hard copy" books lack the current information required for a sufficient analysis needed in a topic as defined in this thesis. The major contributors to the raw data collected was drawn from the Federation of American Scientists (FAS), Bell, Boeing, and Lockheed-Martin corporation web sites. This data was compared to such web sites as US Marine Corp Factfile and US Navy Factfile for accuracy. Additionally, Janes was also used as a cross reference, but found to be too disjointed for use in this thesis. Using the data collected from the sources mentioned previously, the first section to be analyzed is current operational platforms.

Current Platforms

Dominant Maneuver

Both assault support and AAW play a vital role in dominant maneuver (figure 2); however, only AAW will be discussed in depth. Assault support will be analyzed in conjunction with the criterion of precision engagement. The MAGTF has a variety of organic capabilities to conduct AAW operations including aircraft, ground-based air defense weapons, artillery, reconnaissance forces, and air command and control facilities.[1] The primary aircraft that conducts AAW is the F/A-18. According to *MCWP 3.2 Aviation Operations*, the AV-8B and the AH-1W also provide a primary function of AAW. However, this thesis defines their primary focus in the OMFTS concept as OAS. Therefore, their capabilities will not be discussed in this section, but will be evaluated in conjunction with OAS in support of precision engagement. However, a brief summary of

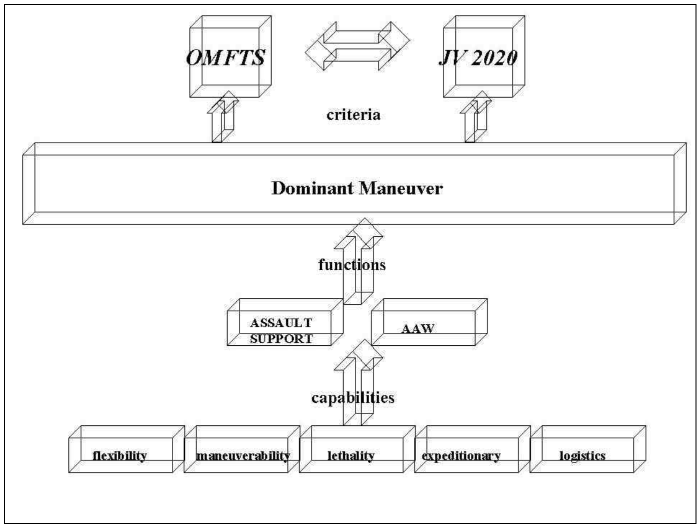

Figure 2. Dominant Maneuver.

their AAW capabilities will be discussed in the summary at the end of the dominant maneuver subsection.

The five capabilities of flexibility, maneuverability, lethality, expeditionary, and logistics will be utilized to analyze the ability of the F/A-18 to conduct AAW in support of dominant maneuver. The F/A-18 single and dual-seat, twin-engine multimission tactical aircraft was designed from its inception to carry out both air-to-air (A/A) and air-to-ground (A/G) missions. Its flexibility can be attributed to the ease in which the F/A-18 can be redirected to an A/A or strike mode, by the simple flip of a switch. The F-4 Phantom, A-7 Corsair, and A-6 Intruder were replaced by the inherent flexibility of the

F/A-18. During Operation Desert Storm, F/A-18s routinely performed fighter and strike missions on the same sortie.[2] For example, on the first day of Desert Storm, two F/A-18s, each carrying four 2,000 pound bombs, shot down two Iraqi MIGs and then proceeded to deliver their bombs on target.

The next capability is maneuverability. Superior turn characteristics coupled with an enhanced thrust-to-weight ratio enable the F/A-18 to out maneuver adversarial aircraft. The exceptional maneuverability of the F/A-18 is a result of a digital fly-by-wire (FBW) flight control system that offers considerable redundancy in case of system failure. The FBW system will not allow the pilot to overstress the airframe. Since 1991, F/A-18s have been delivered with F-404-GE-402 enhanced performance engines that produce up to twenty percent more thrust than previous F404 engines. The Hornet's two engines deliver about 36,000 pounds of combined thrust and a top speed of more than Mach 1.8. A hands-on throttle and stick (HOTAS) places all required controls for combat on either the throttle or stick for easy access, thus allowing the pilot to remain "eyes on target" which further enhances its maneuverability.

The third capability in evaluating the F/A-18 is lethality. The F/A-18 can fire a variety of A/A missiles, employ high-speed anti-radiation missiles (HARM), and drop ordnance against offensive AAW targets. It's A/A missile arsenal consists of the AIM-9M Sidewinder, the AIM-7 Sparrow, and the AIM-120 AMRAAM. The AIM-9M is a short-range, infrared heat-seeking missile. The infrared system enables the missile to home in on the engine exhaust of the target aircraft. It is the most widely used A/A missile in the West, with more than 110,000 missiles produced for 27 nations, excluding the United States.[3] The AIM-9X, a follow on variant to the AIM-9M has received

authorization to enter Low Rate Initial Production (LRIP) with initial operational capability by FY 2003. It will incorporate high offboresight acquisition and engagement capability as well as thrust vector control for extreme agility in all aerial combat environments.[4]

The AIM-7 sparrow is a medium range radar guided A/A missile with an all weather capability. It is expected to be phased out of the operational inventory by FY08 and be replaced by the AIM-120 AMRAAM missile. The AMRAAM is faster, smaller, and lighter, and has improved capabilities against low-altitude targets. It also incorporates active radar in conjunction with an inertial reference unit and microcomputer system, which makes the missile less dependent upon the fire control system of the aircraft. Once the missile closes in on the target, its active radar guides it to intercept. This enables the pilot to aim and fire several missiles simultaneously at multiple targets and perform evasive maneuvers while the missiles guide themselves to the targets.[5] The F/A-18 also has a vast array of A/G munitions, but these will be discussed in conjunction with OAS in support of precision engagement.

The F/A-18 does have the flexibility, maneuverability, and lethality to effectively conduct AAW operations in support of dominant maneuver and the OMFTS concept. However, the F/A-18 has a limited expeditionary capability. It can operate in austere conditions, but a traditional prepared surface is required in order for it to operate successfully. It does not support the true capability of the expeditionary environment, in that it lacks a V/STOL capability. Additionally, it does not support the concept of an all V/STOL aviation force as envisioned by Commandant Greene in 1965 and Commandant Krulak in 1995.

The final capability in evaluating the F/A-18 is logistics. Since its inception the F/A-18 has been designed to be logistically supportable and upgradeable. The F/A-18 was the first tactical jet to incorporate a digital MUX bus architecture for the entire systems avionics suite. The benefit of this design feature is that the F/A-18 has been relatively easy to upgrade on a regular, affordable basis. Additionally, reliability and ease of maintenance were emphasized in its design, giving F/A-18s the ability to have consistently flown three times more hours without failure, while requiring half the maintenance time, as opposed to other current tactical aircraft.[6] Its logistical limitations will become evident as more advanced technological threats emerge. Due to constant upgrades of the F/A-18 in response to technological advances, it has become clear that avionics cooling, electrical, and space constraints would limit future growth. The answers to these deficiencies are being addressed by the development and procurement of a V/STOL variant JSF. A discussion of the JSF will be presented at the end of this chapter.

The AV-8Bs and the AH-1Ws primary function is OAS; however, they can provide a limited AAW function. The AV-8B has the flexibility, lethality, and expeditionary capabilities to conduct AAW; however, it is limited in maneuverability (i.e. maximum speed) and logistics (i.e. maintenance issues). The AH-1W has the flexibility and expeditionary capabilities but lacks maneuverability (i.e. fixed-wing vs. helicopter) and lethality (i.e. limited A/A weapons capability). At the time this thesis was written, the F/A-18 is very capable of conducting the AAW function in relation to dominant maneuver; however, a suitable replacement needs to be incorporated prior to 2010 to be able to meet emerging technological threats.

Such emerging threats include nuclear, chemical, and biological weapons of mass destruction (WMD). These WMDs provide other nations an ability to respond when lacking the economic or conventional military capability to confront the U.S. In the 2010-2020 timeframe, the U.S. may not have a monopoly on Directed Energy Weapons (DEW) (i.e. lasers). This technological advancement will significantly change the way warfare will be planned and conducted. For an asymmetric response, a nation may seek to thwart U.S. air superiority through the use of hardened and underground facilities.[7] The list can go on, but these are a few examples of the challenges that will be faced in the 2010-2020 timeframe.

Precision Engagement

Both OAS and assault support play a vital role in precision engagement (figure 3). The F/A-18 performs the OAS function, while the AV-8B and AH-1W can perform both the OAS and assault support functions in support of precision engagement. The F/A-18, AV-8B, and AH-1W will be associated with the OAS function, while the UH-1N, CH-46E, and CH-53E will be associated with the assault support function. The analysis of the F/A-18s capabilities of flexibility, maneuverability, expeditionary, and logistics, as presented in dominant maneuver, remain the same for precision engagement. The only capability that requires analysis in relation to OAS and precision engagement is lethality.

The F/A-18 has an impressive arsenal suite to conduct strike sorties. This arsenal suite consists of the AGM-65 Maverick missile, AGM-84 Harpoon/SLAM (Stand-off Land Attack Missile), AGM-88 HARM, CBU-59 cluster bombs, GBU-10/12 laser guided bombs, MK 80 series general purpose bombs, and an internal 20mm M61A1 Vulcan cannon.

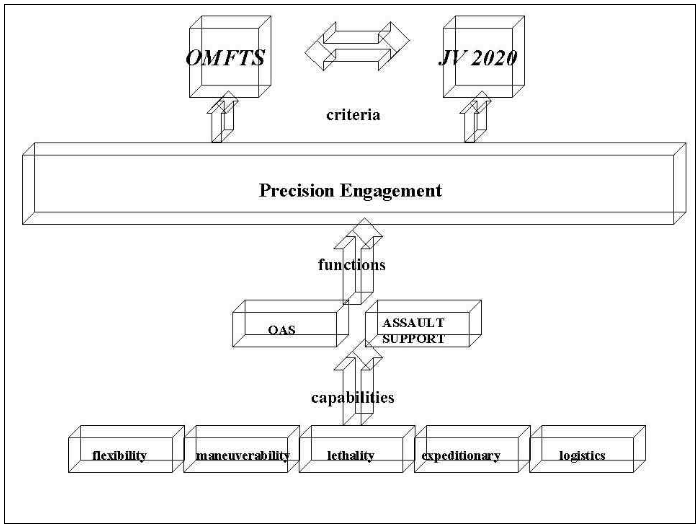

Figure 3. Precision Engagement.

The AGM-65 Maverick is used against fortified ground installations, armored vehicles and surface combatants. It is used in conjunction with ground or airborne laser designators within a sector 7 miles across and over 10 miles ahead.[8] The AGM-84 Harpoon/SLAM is an intermediate range weapon system designed to provide day, night, and adverse weather precision strike capability against high value land targets and ships in port. It uses an inertial navigation system with Global Positioning System (GPS), infrared terminal guidance, and is fitted with a Tomahawk warhead for better penetration. It was employed successfully in Operation Desert Storm and UN relief operations in Bosnia prior to Operation Joint Endeavor.[9]

The AGM-88 HARM is designed to seek and destroy enemy radar-equipped air defense systems. It can detect, attack, and destroy a target with minimum aircrew input. Guidance is provided through reception of signals emitted from ground-based threat radar. The AGM-88 has the capability of discriminating a single target from a number of emitters in the environment.[10] The CBU-59 is a cluster bomb that consists of 717 smaller bomblets that have armor-piercing, antipersonnel fragmentation, and incendiary features. The GBU-10/12 laser guided bombs utilize a 2000 or 500 pound general-purpose warhead, respectively. The operator illuminates a target with a laser designator and then the munitions guide to a spot of laser energy reflected from the target.[11] These munitions were used during Desert Storm and statistically hit between 78 to 88 percent of their targets.

The MK-80 series (81, 82, 83, and 84) was developed in the 1950s in response to the need for bombs producing less aerodynamic drag. They are fitted for both nose and tail fuses to ensure reliability and produce effects of blast, cratering, or fragmentation. During Desert Storm the MK-80 series were used against a wide variety of targets, including artillery, trucks, bunkers, scuds, surface-to-air missile sites, antiaircraft artillery sites, early warning radars, and supply points.[12]

As mentioned in dominant maneuver, the F/A-18 does have the flexibility, maneuverability, and lethality to conduct the AAW function. In precision engagement, the F/A-18 successfully maintains the same capabilities to conduct the OAS function in support of precision engagement. Its ability to carry a variety of highly sophisticated munitions gives the MAGTF the precision strike capability it needs to augment the GCE.

However, it still suffers the same limitations of expeditionary and logistics capabilities as defined in dominant maneuver.

The next platform to discuss in relation to OAS and precision engagement is the AV-8B. The five capabilities in figure 3 will be utilized to analyze the AV-8B. The first capability to be discussed is flexibility. The AV-8B Day Attack (DA) Harrier replaced the A-4M Skyhawk and the initial procurement of the British built AV-8As in 1985. Since then, there have been two other variants that have been developed for the MAGTF. The Night Attack (NA) variant replaced the DA AV-B in 1990. The changes included the replacement of the F402-RR-406 engine with an improved F402-RR-408 Rolls Royce Pegasus turbofan engine. Additional installed equipment included a Navigation Forward Looking Infrared (NAVFLIR), a Digital Mapping Unit (DMU), night vision goggle (NVG) capability, and a wide-field-of-view Heads Up Display (HUD) giving the AV-8B the versatility it needed for night attacks. In 1993, a Radar variant was developed which included the NA capability and the incorporation of the AN/APG-65 Radar. This radar was designed to significantly enhance A/G and A/A efficiency. In 1994, the Marine Corps started a process of converting DA AV-8Bs to the Radar variant. This REMAN process illustrates the flexibility envisioned by the Marine Corps to have a viable OAS platform in direct support of the MAGTF.

The next capability is maneuverability. The AV-8B utilizes a vectored thrust providing between 20,000 and 23,000 pounds of thrust for a maximum speed of 550 knots. This vectored thrust differs from conventional exhaust nozzles. It can position its swiveling exhausts for hovering flight and for better combat maneuvering. The significant aerodynamic features of the aircraft are large Leading Edge Root Extensions

(LERX), under fuselage lift improvement devices (LIDS), drooping ailerons and the slotted flaps augmented vectored engine thrust, which all considerably enhance flight maneuverability.[13]

The lethality of the AV-8B is the next capability to be analyzed. The principal attack system in the AV-8B is either the angle-rate bombing system (ARBS) in the NA Harrier or a variant of the F/A-18 AN/APG-65 radar in the Radar Harrier. The ARBS has a laser spot tracker, which provides first pass day or night target strike capability at low altitude/high airspeed. The AN/APG-65 radar extends the tracking capabilities of the aircraft for A/G and A/A defense modes.[14] The NA/Radar AV-8B upgrade program has incorporated an Airborne Target Handoff System (ATHS) and GPS capability into the aircraft. ATHS allows direct digital target/mission data exchange between the pilot and ground units while the GPS integration improves navigational and weapons delivery accuracy.[15] The aircraft carries an external 25-mm gunpack faired into the underfuselage, with a 1000-lb capacity fuselage hardpoint, four 2,000-lb capacity wing pylons, and two 620-lb capacity outboard pylons available for bombs, rockets, A/G and A/A missiles and fuel tanks. Outrigger pylons were added to later variants of the AV-8B.[16] The type of munitions the AV-8B can carry are a GAU-12/U gunpod, AGM-65 Maverick Missile, AGM-84 Harpoon, GBU-12/16, CBU-99/100 cluster bombs, MK-80 series general purpose bombs, 2.75” and 5” rockets, AIM-7 sparrows, AIM-9M Sidewinders, and the AIM-120 AMRAAM. The GAU-12 25mm gunpod has a 300 round capacity with a lead computing optical sight system (LCOSS) gunsight. The GBU-16 utilizes a 1000-lb general-purpose warhead with the same operating characteristics as mentioned in the F/A-18 analysis of the GBU-10/12.

Expeditionary is the next capability to analyze the AV-8B in its ability to conduct OAS in support of precision engagement. The AV-8B V/STOL capability is the most advanced of any nation. It supports the vision of a V/STOL tactical platform that can operate in virtually any environment in direct support of the MAGTF GCE. During Operation Desert Storm, the AV-8B operated 35nm from the Kuwait border, making them the most forward deployed tactical aircraft in theater. This aircraft is ideally suited for providing dedicated close air support.

The final capability to analyze is logistics. The REMAN program (approximately 80 percent cost of a new aircraft) extends the service life of the AV-8B, which greatly improves its flexibility, maneuverability, and lethality. Additionally, the Open Systems-Common Architecture (OSCAR) program utilizes a commercial off the shelf (COTS) system that can be more affordably upgraded and maintained.[17] However, the logistics capability is probably the most demanding issue facing the AV-8B today. The AV-8B 402 series engines have experienced numerous difficulties over their years of use. Such problems were digital electronic fuel control unit anomalies and reliability of the number three bearing assembly within the engine. Problems such as these have led to numerous and continual groundings of the aircraft fleet. Recently, the Marine Corps received approval from the Joint Chiefs to cease deployments of the AV-8Bs for the purpose of repairing the battered fleet and to ensure pilot proficiency.

The AV-8B is the most viable tactical aircraft platform to support the OMFTS concept. Its flexibility can be illustrated by the latest variant that has been developed, which gives the MAGTF a close air support night and adverse weather capability. Its V/STOL technology and ability to operate from remote tactical areas give the MAGTF

the maneuverability and expeditionary capabilities to fulfill the OMFTS concept. It supports the vision of an all V/STOL force as described by Commandant Greene in 1965. The AV-8s REMAN program extends its service life thus providing a cost effective solution until its replacement by the JSF. However, the downside is that its suspect engine issues have led to numerous groundings, which fosters an air of unreliability within the MAGTF and Naval Expeditionary Force. As mentioned earlier, it has been removed from the current fleet deployment schedule until maintenance discrepancies can be fixed and pilot proficiency can be regained. Therefore, it is imperative that the JSF replace the AV-8 during the scheduled timeframe of 2008.

The final platform to be analyzed in relation to OAS in support of precision engagement is the AH-1W Cobra attack helicopter. The first capability is flexibility. The AH-1W is a twin-engine attack helicopter with the flexibility to conduct multiple missions. These missions can range from CAS; escort of other aviation platforms or ground troops; a limited A/A capability, anti-shipping operations; and forward air control (FAC) of fixed wing CAS, artillery, and naval gunfire. The ability to utilize external fuel pods gives the AH-1W the flexibility to operate in the tactical environment for extended periods. Additionally, the AH-1W has the ability to conduct operations in adverse weather conditions, both day and night.

For maneuverability, the Marine Corps has incorporated the T-700-GE-401 engine in the AH-1W, which provides a 65 percent improvement in available power. It has the highest power-to-weight ratio of any attack helicopter. This translates into an outstanding hot day, payload, and range performance.[18]

The AH-1W is one of the most lethal attack helicopters in the U.S. inventory. The aircraft is equipped with a 20mm M197 gun in the nose turret and can carry 2.75" and 5.0" rockets, Hellfire and TOW anti-armor missiles, AIM-9 Sidewinder missiles, and Sidearm anti-radiation missiles[19] The three-barrel 20mm gatling gun has a 750 round capacity that is a deadly force for close range support. The laser guided Hellfire can effectively defeat heavy armor and hardened fortifications at ranges in excess of 3.24 NM while the wire-guided TOW can be utilized at ranges exceeding 1.62 NM. A Night Targeting System (NTS) is incorporated in the AH-1W that integrates the TOW and Hellfire missile systems with FLIR, laser range finder/designator, automatic target tracker, TV and a video recorder, giving it a fire and forget capability.[20] The AH-1Ws lethality is evident by the destruction it caused during Operation Desert Storm. It destroyed 97 tanks, 104 armored personnel carriers and vehicles, 16 bunkers, and two antiaircraft sites.[21]

Expeditionary capabilities are inherent in helicopter platforms. The AH-1W operates from naval vessels and prepared and unprepared surfaces in both day and night conditions. Its ability to operate at or near the forward line of troops is vital to fire support required by the MAGTF.

The final capability is logistics. The AH-1W has a low maintenance per flight hour ratio. This was evident during Operation Desert Storm. The AH-1W comprised only 20 percent and flew more than 50 percent of the total attack helicopter force. This equates to more than three times as many flight hours as other attack platforms. Its reliability and 92 percent mission readiness rate exceeded all other attack helicopters by 24 percent.[22]

Before moving on to assault support in relation to precision engagement, it is important to discuss the upgrade of the AH-1W to the AH-1Z Super Cobra (4BW). After four years of development the AH-1(4BW)Z made its first flight on 7 December 2000. The Marine Corps plans on remanufacturing 180 AH-1Ws to the AH-1(4BW)Z, which will give the Super Cobra an extended lifespan until its replacement in 2020. The AH-1(4BW)Z will significantly increase the speed, range, maneuverability, lift, and logistical support capability. It will incorporate a four bladed rotor system that will allow the aircraft to sustain higher G loads with an increase in the functional flight envelope. The ordnance capability will be increased with the addition of extra wing storage stations. Additionally, an ATHS will allow the AH-1Z to work hand in hand with the AV-8B. An Integrated Helmet Mounted Display and Sighting System (IHMDSS) will project data from all aircraft sensors onto the visor of the pilot, significantly reducing the workload. For an expeditionary capability, the AH-1Z will incorporate a semiautomatic blade fold capability for confined area storage. Logistically, spare parts will be reduced by 70 percent since this program shares common parts with the UH-1Y remanufacture program, which will be discussed in the next section. The AH-1Z will become the ideal platform to support precision engagement and the OMFTS concept.

The next function of Marine aviation to evaluate in support of precision engagement is assault support. The three platforms to be evaluated are the UH-1N, CH-46E, and the CH-53E. The UH-1N will be discussed first.

The UH-1 is a utility helicopter that was initially developed during the Vietnam War, which proved its durability and flexibility. Since then, there have been many variants of this platform. It has been used by all four services as well as international

forces. Currently, the Marine Corps utilize the UH-1N. This variant is a flexible platform able to perform numerous functions ranging from air assault; medical evacuation; airborne command and control; terminal guidance for supporting arms to include CAS, artillery, and naval gunfire; and general utility transport missions. Integrated communication and navigation systems including a GPS/Doppler and numerous multi-channel radios with satellite communication capabilities are installed in the UH-1N. It also has the ability to conduct operations in both day and night adverse weather conditions. A NVG HUD and an integrated FLIR for night navigation and targeting augment this capability. In 1998, FLIR Systems Incorporated (FSI) was awarded a contract to upgrade the current UH-1N imaging system with a Star SAFIRE airborne imaging system. This system employs advanced thermal imaging (infrared) technology and three optical fields of view for long-range identification and image clarity under the most adverse conditions. This systems improved visual range combined with an eye-safe Laser Rangefinder will allow for faster identification of objects and quicker reaction times.[23] This will greatly enhance navigation, surveillance, and target recognition. These multimission capabilities are a prime example of the inherent flexibility of the UH-1N.

For maneuverability, the UH-1N has two T400-CP-400 turbo shaft engines with a speed capability of 121 knots at sea level. The lethality of the UH-1N is shown by its ability to carry M-60 7.62mm, M240 7.62 mm, and GAU-16 .50 cal machine guns; the GAU-2B/GAU-17 7.62mm automatic guns; and two seven shot or nineteen shot 2.75" rocket pods.[24] The machine guns and automatic guns are all crew served weapons;

however, the GAU-2B/GAU-17 can be fired by the pilot in the fixed forward firing mode.

As mentioned earlier, helicopters have an innate expeditionary capability. The UH-1N can operate in both prepared and unprepared confined sites, in day or night conditions. In assault support logistics, the UH-1N is able to transport a limited amount of cargo and personnel. In the medical evacuation mode it has the ability to transport six litter patients and one medical attendant. As far as maintenance and supportability, the UH-1N is going through the same upgrade as mentioned in the AH-1W. In August 1998, three UH-1Ns were delivered to Bell Helicopter for conversion into the UH-1Y test aircraft. This program will remanufacture approximately 100 UH-1Ns to the UH-1Ys. The first UH-1Y will fly during 2001 with an expected operational implementation in 2003. The UH-1Y will have commonality in parts as mentioned in the AH-1Z and will significantly improve speed, range, maneuverability and lift capability.

The next platform to discuss in relation to assault support and precision engagement is the CH-46E. The CH-46 was designed as an interim aviation platform during the Vietnam War until a suitable replacement could be identified. Three decades later, a variant of the CH-46, the CH-46E is still in the operational fleet. The CH-46E is the Marine Corps primary troop carrier. It has the flexibility to perform the assault troop mission in day or night adverse weather conditions with the addition of NVG compatibility. Secondary functions are the transport of cargo, search and rescue, and medical evacuation. The CH-46 has two GE-T58-16 engines, which give it a maximum speed capability of 145 knots. The CH-46E has a limited lethality capability with two crew served .50 cal machine guns located on the port and starboard side of the aircraft.

The expeditionary capability allows the CH-46E to make confined area landings and take offs, which are needed for inserting combat troops directly to the objective.

Logistically, the CH-46E is capable of ferrying a maximum of 14 combat loaded troops with two aerial gunners. A secondary mission of medical evacuation gives the CH-46E a capability of transporting 15 litters with two medical attendants. In 1997, the CH-46E fleet started a Dynamic Component Upgrade (DCU), a fix designed to enhance the aircraft's lift and mission capability. The upgrade was designed to modify the aircraft's drive, flight control and rotor systems resulting in improved lubrication, decreased component wear and increased service life, improved fault detection and reduced maintenance requirements. Allowing an additional 2,300-pound payload for mission accomplishment also enhanced the lift capability.[25] However, due to the age of the aircraft, there is an issue with reliability and maintainability. Even with the DCU, the safe and effective operation of the CH-46E is limited. Therefore, it is imperative that a replacement, such as the MV-22, be fielded as soon as possible. The MV-22 will be discussed in the projected platforms section of this chapter.

The final platform to be discussed in relation to assault support and precision engagement is the CH-53E. The CH-53E is the Marine Corps only heavy lift platform. Its primary mission is transportation of supplies in support of the MAGTF. The flexibility of this heavy lift platform allows it to conduct other missions such as Tactical Recovery of Aircraft and Personnel (TRAP) and troop transport. It was the platform that rescued Captain Scott O'Grady when he was shot down conducting a tactical mission over Bosnia in June 1995. Its aerial refueling capability gives this aircraft unlimited range. During Operation Eastern Exit, two CH-53Es launched from amphibious ships

and flew 463 NM at night, refueling twice enroute to rescue American and foreign allies from the American Embassy in Mogadishu, Somalia in January 1990.[26]

The CH-53E is a follow on variant of the CH-53D two-engine helicopter. The addition of a third engine and a seventh rotor blade gave the CH-53E the maneuverability it required to become the premier heavy lift platform needed for the MAGTF. Another improvement was the 20-degree canting of a larger vertical tail so that the tilted tail rotor provided some lift in a hover while counteracting the main rotor torque.

The CH-53E has the same limited lethality of the CH-46E consisting of two .50 cal machine guns located on the port and starboard side of the aircraft. The CH-53E is significantly bigger than a CH-46E but still retains the innate expeditionary capability associated with helicopters. It does have an automatic blade and pylon fold system to reduce its large footprint. The CH-53E can operate in austere conditions in both day and night operations. It is augmented by a dual digital automatic flight control system giving it an all weather capability.

For logistics support of the MAGTF, the CH-53E can carry an internal load of six pallets of stores, thirty-six combat loaded troops or fifty-five with centerline seating installed. Externally, it is capable of lifting thirty six thousand pounds via a single point or dual point cargo hook system. For a secondary mission of medical evacuation it can hold twenty-four litters with medical attendants. There have been numerous service life extensions (SLEP) that have increased the lifespan of the CH-53E. As of yet, there has been no identified replacement for this aircraft. It is expected that this aircraft will serve the fleet until the 2025 timeframe. This platform is a viable asset in supporting the

OMFTS concept by being able to move artillery, armored personnel carriers, light tanks, fuel bladders, and troops both internally and externally around the battlefield.

There are numerous platforms that have been discussed in the precision engagement section. The F/A-18 and the AV-8B are combat proven and were successfully employed during the Gulf War. They both have the flexibility, maneuverability, and lethality to conduct the OMFTS concept; however, there are some limitations that were previously discussed. The F/A-18 has a limited expeditionary capability, whereas the AV-8B has a logistics capability shortfall.

The AH-1W and UH-1N both have the flexibility to conduct multiple missions. The AH-1W is one of the most lethal helicopters in the world. It employs a variety of A/G weapons to support the GCE. The AH-1W is not designed for AAW; however, its flexibility allows a limited self-protection AAW function. Expeditionary capabilities are inherent in helicopters; therefore, by virtue of vertical lift, the AH-1W and UH-1N meet the expeditionary requirements needed in the OMFTS concept. As far as logistics supportability, both platforms will go through a service life extension to fill the gap until their replacement in the 2020 timeframe. This upgrade to the AH-1Z and the UH-1Y will significantly increase the speed, range, maneuverability, lift, and logistical support capabilities needed to successfully accomplish the OMFTS mission in the 21st century.

The CH-46E and CH-53E are the virtual workhorses for the MAGTF. Although the CH-46E is the Marine Corps primary troop carrier, its operational existence for over thirty years has reached its useful end. The CH-46E is a viable and versatile platform; however, it is in need of a replacement. The MV-22 has been identified as its replacement. The 2003 fleet implementation date has been delayed by an undeterminable

amount of time. Recent crashes have led to skepticism in the MV-22s operational capabilities. What needs to be realized is that the MV-22 is a viable platform that meets the OMFTS requirements and needs to be introduced into the fleet in a quick, albeit safe, manner in order to rescue the continued declining performance of the CH-46E. The CH-53E is the primary heavy lift mover for the MAGTF. It has the flexibility to conduct multiple transport missions, either internally or externally. There has been no identified replacement for the CH-53E, but it is estimated that a replacement will be fielded in the 2025 timeframe.

Full Dimensional Protection

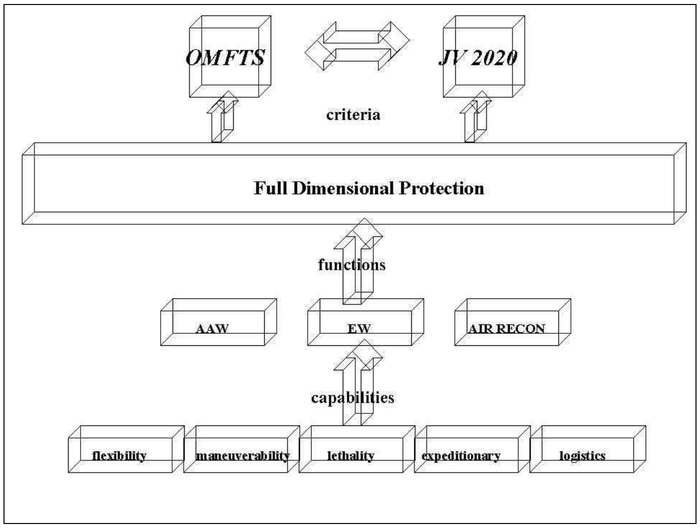

Figure 4. Full Dimensional Protection.

As mentioned in chapter Three, AAW, EW, and air reconnaissance can be linked to full dimensional protection (figure 4). It is important to understand that these three functions fill in the vulnerability gaps where OTH protection fails. To reiterate, most of the Marine aviation functions share a relationship between the four criteria of Joint Vision 2020. AAW has already been discussed; therefore, EW and air reconnaissance will be discussed in depth.

The only platform to discuss in relation to EW and full dimensional protection is the EA-6B. With the retirement of the F-4G Wild Weasel and the EF-111A Raven, the EA-6B has become not only a MAGTF asset but a national DOD asset as well. It is the only EW tactical aviation platform within the Defense inventory. The flexibility of the EA-6B is evident by its multi-mission capability. It can conduct EA, ES, EP, and launch HARM anti-radiation missiles and SEAD attacks. For maneuverability, it has two Pratt and Whitney J52-P408 turbofan engines, giving the EA-6B a maximum cruise speed capability of .99 mach.

The lethality of the EA-6B consists of an AN/ALQ-99 Tactical Jamming System (TJS). The EA-6B has the ability to carry up to five pods (one under the centerline fuselage and two on each wing). Each pod is integrally powered and houses two jamming transmitters that cover one of seven frequency bands. Additionally, the EA-6B can carry HARM anti-radiation missiles depending on mission requirements.[27] The tail fin of the EA-6B houses sensitive receivers capable of detecting hostile radar emissions at long range. Identification, direction finding, and jammer-set-on-sequence of the emissions may be performed automatically or by the crew.[28] The EA-6B is also integrated with the Tactical Electronic Processing and Evaluation System (TERPES).

This system provides the MAGTF commander with post-mission analysis of EA-6B data for reporting orders of battle, jamming analysis and HARM employment.

The EA-6B has a limited expeditionary capability. It is primarily a land-based asset; however it can operate from carriers and prepared expeditionary airfields. Like the F/A-18, it does not support the V/STOL vision of both Commandants Greene and Krulak.

Its constant use since its integration into the fleet in 1977, coupled with advances in technology, were beginning to make the EA-6B an obsolete tactical platform until it received a Block 89A upgrade. The Block 89A upgrade addressed structural and supportability problems associated with the aging fleet of aircraft. Additionally, it includes numerous improvements for safety of flight and joint interoperability.[29] The EA-6B is the only platform within the MAGTF that can successfully perform the EW function, but it must also be remembered that it is a joint Department of Defense asset as well. This could possibly limit the availability of this asset to the MAGTF when it is needed most. Even though the JSF is still in the Concept Demonstration Phase, an additional requirement that could be added is an EW function. This option could serve two purposes. First, it could free up the EA-6B for joint requirements in other arenas, and secondly, it would address the platform neck-down strategy as envisioned by Commandant Krulak in 1995.

The next function to analyze in relation to full dimensional protection is aerial reconnaissance. It is important to understand that all ACE platforms can perform a limited role in aerial reconnaissance; however, the dedicated platform that has this function as one of its primary missions is the F/A-18D. Most of the F/A-18s capabilities have been evaluated; therefore, only the Advanced Tactical Air Reconnaissance System

(ATARS) will be discussed. The Navy recently announced that it would approve full rate production of the ATARS system to be incorporated into the F/A-18D. It is an all weather reconnaissance system that is fitted into the nose bay of the F/A-18D, providing the capability for pre-and post-strike mission assessments. This capability closes the gap left when the RF-4 Phantom was retired.

AAW, EW, and air reconnaissance all play an important role in full dimensional protection. As mentioned in chapter three, AAW has a dual purpose of providing dominant maneuver and full dimensional protection. The F/A-18 has the flexibility, maneuverability, and lethality to successfully augment the protection of the force. The F/A-18 and the EA-6B have the ability to detect, identify, and engage targets, whether fixed or maneuvering to threaten the naval expeditionary force. As mentioned earlier, all aviation platforms play a role in air reconnaissance. The primary purpose of air reconnaissance is to provide the commander with the intelligence needed to execute missions as well as protect the force. The F/A-18, AV-8B, and EA-6B provide the commander with that capability. In the OMFTS concept, a majority of full dimensional protection is fulfilled by OTH operations. However, the F/A-18, AV-8B, and EA-6B fill in where gaps occur.

Focused Logistics

After troops have reached their objectives, they will continue to conduct sustained operations ashore. Certain aviation platforms must have the capability to conduct timely logistical support in relation to the MAGTF commander's needs. Assault support plays a vital role in precision engagement by bringing troops directly to the objective. However, the assault support function also plays an integral part in focused logistics by supporting

those troops when they are at the objective or continue to conduct sustained operations ashore (figure 5). The CH-46E, CH-53E, and KC-130 all provide logistical support to the MAGTF. However, the CH-46E and CH-53E have dual functions. These platforms can deliver troops to the objective and can deliver logistical support, as mentioned above. In the OMFTS concept, the KC-130 does not deliver troops straight to the objective. Once the objectives have been met in the OMFTS concept, and the MAGTF is conducting sustained operations ashore, the KC-130 becomes the primary platform in relation to the function of assault support and focused logistics. The CH-46E and CH-53Es capabilities have already been analyzed. Therefore, only the KC-130 will be discussed in this section; however, a summary of all three platforms will be conducted at the end of this subsection.

The KC-130 has the flexibility to provide aerial refueling (ground refueling when desired) to both tactical fixed-wing and rotorcraft. Additionally, it can transport troops, deliver supplies, conduct medical evacuation operations, and numerous other special operations when needed. The KC-130 has four Allison T-56-A-16 engines giving it a cruise speed of 315 knots. Since the KC-130 is a tanker/cargo transport aircraft it has no lethality capability. The KC-130 has the ability to operate from primitive landing strips and short runways.

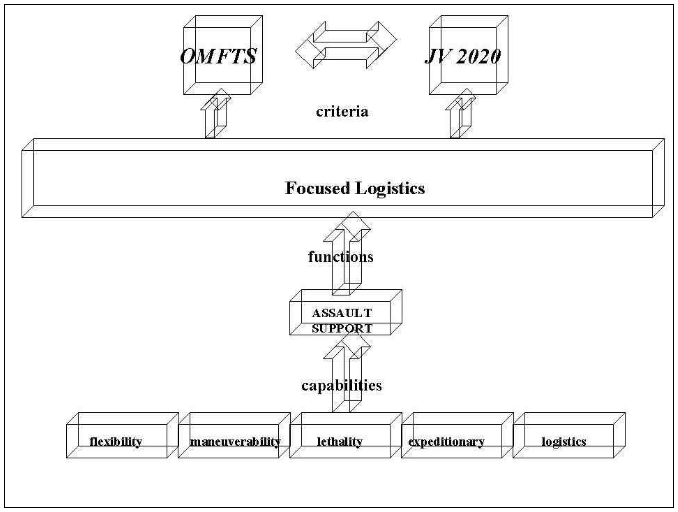

Figure 5. Focused Logistics.

The Marine Corps operates both the KC-130F and T models. Recently, the Marine Corps started procuring a new variant, the KC-130J. The KC-130J incorporates an integrated digital avionics suite (embedded GPS) with heads-up displays, new propulsion system (higher power turboprop engines with more efficient six-bladed all composite propellers) and other major upgrades that reduce operating costs and crew size while offering significant performance improvements.[30] The KC-130J can carry 92 ground troops or 64 paratroopers and equipment. In the medical evacuation role, the KC-130 can configure its cargo hold to carry 74 litters plus medical attendants. The KC-130J will give the MAGTF the ability to conduct logistics in support of OMFTS in the twenty first century.

As mentioned in assault support, the CH-46E, and when needed, the CH-53E, are the primary workhorses in delivering troops to the objective. The OMFTS concept stresses the need to deliver troops at a time and place where the enemy is weakest. Once these troops have been inserted, focused logistics plays an important part in sustaining those operations. Operational tempo and momentum would not succeed if focused logistics cannot be accomplished. The ability of the CH-46E, and more importantly, the CH-53E to deliver supplies at the right place and the right time is imperative for successful MAGTF operations. Once the objectives have been attained, the KC-130 becomes the logistical workhouse by virtue of its range and load carrying capacity. Without these three platforms, the OMFTS concept would never be able to move from concept to operational feasibility.

Projected Platforms

Chapter 1 of this thesis described the evolution of OMFTS and briefly described the four criteria of Joint Vision 2020. Chapter 2 identified the six functions of Marine aviation and the types of aviation platforms associated with the ACE in support of the MAGTF. Chapter 3 developed a methodology to evaluate these platforms in relation to Marine aviation functions and Joint Vision 2020 in support of the OMFTS concept. This chapter has analyzed all the platforms previously mentioned by utilizing the methodology developed in chapter Three. Now that this analysis has been completed, it is important to discuss two critical platforms that are projected to enter the operational fleet within the next two to seven years, the JSF and the MV-22.

The JSF program was formally known as the Joint Advanced Strike Technology (JAST) program, with a goal of developing a common aircraft among three branches of

the services: Air Force, Navy, and Marine Corps. The Marine Corps JSF variant differs slightly from the Air Forces and Navy's by virtue of a Short Take-off Vertical Landing (STOVL) capability. This variant is designed to replace both the F/A-18 and the AV-8 in fiscal year 2008. The Marine Corps is scheduled to acquire 609 STOVL variants. When the JSF replaces the F/A-18 and the AV-8B, it will assume the Marine aviation functions of AAW, OAS, Air Reconnaissance, and possibly EW. To draw the same analogies as with the current aviation platforms section, the JSF will play a vital role in dominant maneuver and precision engagement. Therefore, this thesis will limit analysis of the JSF to these two functions. The first function to be discussed will be dominant maneuver.

Dominant Maneuver

Two major aeronautical manufacturers are vying for production rights to the JSF. In 1996, both Boeing and Lockheed Martin were selected to build prototypes of the JSF in the Concept Demonstration Phase. The victor of this phase is expected to be announced within the next year and will be awarded a production contract in excess of $200 billion.

The Boeing STOVL prototype is labeled the X-32B while Lockheed Martin's is the X-35B. The first capability in evaluating the JSF is flexibility. Regardless of which manufacturer to be awarded the contract, the JSF will have the same ability as the F/A-18, in being able to conduct both A/A and A/G missions in the same sortie. Its ability to conduct multiple missions will be significantly enhanced by its reduced radio frequency/infrared signature. This design feature is one advantage that it will have over the current operational platforms of the F/A-18 and the AV-8B. Additionally, it will have an adverse weather day/night mission and refueling capability to extend range.

For maneuverability, the main difference between the X-32B and the X-35B is the way the STOVL powerplant has been developed. Both prototypes are powered by a Pratt & Whitney F119 derived engine. However, the X-32B has a direct lift design while the X-35B has a shaft driven lift fan design. The X-32B uses a combat proven two-dimensional, flow-blocking cruise nozzle coupled with a simple direct lift nozzle system (figure 6).[31]

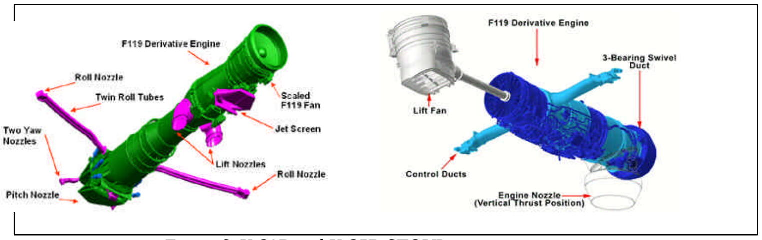

Figure 6. X-32B and X-35B STOVL engines.

The X-35B utilizes a new concept; a shaft driven lift fan design that is provided by Rolls Royce. "The JSF is significantly larger than the Harrier, and our engineering studies concluded it would require a new STOVL propulsion approach," as stated by Lockheed Martin.[32] This STOVL system uses four lift posts to control the aircraft in three axes during flight (figure 6). This new concept enhances STOVL operation in two ways. First it augments thrust to offset the thrust to weight ration incurred by the lift fan. Secondly, it produces cooler air temperatures during ground STOVL operations. However, a slight drawback to this type of design is the elimination of some internal fuel storage due to additional space consumed by the lift fan, resulting in a shorter combat radius. Both the direct lift and the shaft driven designs are viable options for the JSF.

Utilizing the same concept as the AV-8B, this STOVL technology allows for hovering capability and better combat maneuverability.

In response to the capability of lethality, both the X-32B and X-35B will have the ability to carry munitions both internally and externally. Internally, the JSF will carry up to two thousand pounds of ordnance including two AIM-120 AMRAAMS for a medium range A/A capability. It will have four external hardpoints that will be able to carry the AIM-9X Sidewinder missile for a short range A/A capability. An interesting difference between the X-32B and X-35B is that the X-32B has been designed with side mounted weapons bays. Boeing Corporation has stated that "side mounted bays allow the pilot to open the bay away from enemy radar and drop a weapon without compromising the JSF's low observability and the pilot's safety."[33] The X-35B has a traditional weapons storage design where two parallel weapons bays are located in front of the main landing gear.

Expeditionary is the next capability in analyzing the JSF. As mentioned earlier, the JSF will eventually replace the F/A-18 and the AV-8B in the 2010 timeframe. By virtue of the STOVL capability in the JSF, it meets the expeditionary criteria that will be required in the OMFTS concept. As explained in the analysis of the AV-8B, the JSF supports the V/STOL concept as envisioned by both Commandant Greene in 1965 and Commandant Krulak in 1995.

Logistics is the final capability in analyzing the JSF in support of dominant maneuver. The JSF has been designed to have a commonality between the Air Force, Navy, and Marine Corps variants. This commonality is in the range of between 70 to 90 percent. This will significantly reduce the manufacturing, support and training costs over the lifespan of the JSF. The JSF is utilizing the proven principles of the legacy aircraft

(F/A-18, AV-8B) with emerging technology to increase its maintenance reliability, which translates into an increased sortie rate.

The JSF has been toted as the next generation of tactical jets that will meet future threats well into the twenty first century. It will have an adverse weather day/night capability and refueling capability to extend range. More importantly, in this day and age of budgetary restraints, it will prove to be a cost effective solution. The JSF STOVL variant is the most suitable replacement for the F/A-18 and the AV-8B. It encompasses a STOVL technology that will increase the lethality by enhancing its maneuverability. The JSF will have a reduced radar signature as compared to the tactical jets of today's Marine Corps, be able to employ the munitions needed to successfully conduct the A/A mission, and be fitted with a sophisticated computer/avionics suite that will allow continuous software upgrades to meet future emerging technological threats, as mentioned in the current platforms section.

Precision Engagement

As mentioned in the current platforms section, both OAS and assault support play a vital role in precision engagement. The JSF will be the single platform that will conduct the OAS function, while the MV-22 while be the primary platform to conduct the assault support function in support of precision engagement in the 2020 timeframe. The first part of this subsection will discuss the JSF, followed by an analysis of the MV-22.

The JSF capabilities of flexibility, maneuverability, expeditionary, and logistics have already been discussed in the dominant maneuver subsection and apply equally in the discussion of precision engagement. The only capability that will be analyzed in

relation to precision engagement will be lethality. The JSF will have the ability to carry a variety of precision-guided weapons, including all those mentioned for the F/A-18 and AV-8B. One significant advantage of the JSF is that it will be four times as lethal as current aircraft. The Joint Direct Attack Munitions (JDAM) will utilize GPS satellite information to direct the munitions to their target. A unique capability of a JDAM is that is all weather capability, adding to the flexibility of the JSF.

The last platform to discuss is the MV-22 Osprey. As mentioned in chapter two, the MV-22 is the projected medium lift replacement for the aging CH-46E and the CH-53D in the 2003 timeframe. The flexibility of the MV-22 is that it is a tilt-rotor V/STOL aircraft that takes off and lands like a conventional helicopter but can transition to a fixed wing mode in-flight. Its ability to utilize the fixed-wing capability gives it the ability to increase its range to the objective, further enhancing the OTH capability of the naval expeditionary force. Additionally, the MV-22 is self-deployable, air-refueling capable, and has a cruise speed two and one half greater than the current medium lift asset, the CH-46E.

For maneuverability, the MV-22 utilizes an interconnecting shaft that connects both proprotors to two 6150 shaft horsepower (shp) turboshaft engines. As a fail-safe measure, if an engine fails, the interconnecting shaft can drive both proprotors via a single engine. Additionally, the engines and flight controls are controlled by a triple redundant fly-by-wire system.[34] The only disadvantage to this type of technology is that the MV-22 cannot autorotate like a conventional helicopter. Its proprotors are to large to allow an effective safe landing while in the fixed wing mode. As in the flexibility

capability, the concept of a tilt-rotor aircraft significantly enhances the OMFTS concept by virtue of its speed and range capability.

The lethality of the MV-22s is limited. Its lethality can be compared to that of the CH-46E and the CH-53E, with crew served .50 cal machine guns. The MV-22s expeditionary capability is best suited to the OMFTS concept. Not only does it have the innate expeditionary capability of helicopters, but also its fixed wing mode allows it to achieve a momentum and operational tempo that is needed in the OMFTS concept. The MV-22s logistical capability exceeds that of the CH-46E. It can carry twice as many troops four times farther. Externally, it can transport three times the load almost twice as far, which significantly augments the CH-53E logistical support capability.

A look at table 3 shows a comparison between the MV-22 capabilities as compared to the CH-46E. The Key Performance Parameters (KPP) that are displayed are a result of the Joint Requirements Oversight Council's requirements for a medium lift replacement for the CH-46E. For example, if a proposed platform does not meet KPPs then those failures may cause cancellation of that particular program. The MV-22 exceeds the initial KPPs that were established when the Marine Corps was initially looking for a medium lift replacement. Additionally, it far outperforms the diminishing capabilities of the aging CH-46E.

When examining *MCDP 1, Warfighting*; *MCDP 1-3, Tactics*; and the *OMFTS* concept paper; it can be derived that the MV-22 is a vital link to the successful accomplishment of the OMFTS concept in the 21st century. Of all the consistent patterns that can be discerned in war, there are three concepts of universal significance in generating combat power: speed, focus, and surprise. Speed is the rapidity of action.

Focus is the generation of superior combat power at a particular time and place. Finally, surprise is achieved by striking the enemy at a time or place or in a manner for which the enemy is unprepared. It is not essential that the enemy be taken unaware, but that the awareness came too late to react effectively.[35]

Table 3. MV-22/CH-46E capabilities. Source: The MV-22 Osprey, Part I, Performance Parameters and Operational Implications, Marine Corps Gazette, March 1999.

Mission Radius	Key Performance Parameters	MV-22 Projection	Current CH-46E Capability
Pre-Assault/Raid (18 troops)	200 NM	273 NM	75 NM (12 troops)
Land Assault (24 troops)	200 NM	277 NM	75 NM (12 troops)
Land Assault (10K external load)	50 NM	75 NM	3K External Load @ 50 NM
Amphibious Assault (24 troops)	2 X 50 NM	2 X 97 NM	50-75 NM (12 troops)
Amphibious Assault (10K external load)	50 NM	123 NM	3K External Load @ 50 NM
Self-Deploy with (1) Aerial Refueling	2100 NM	2631 NM	N/A
MV-22 Cruise Speed	240 KTS	275 KTS	

The MV-22, combined with the JSF are a formidable duo, which are needed to successfully accomplish the OMFTS mission in the 21st century. Both platforms' technological advancements and V/STOL capabilities will allow the Marine Corps to fully support two of the six principle tenants of OMFTS: generate overwhelming tempo and momentum, and the ability to pit strengths against enemy weaknesses.

Chapter One of this thesis has shown the evolution and technological advancements of amphibious warfare, and introduced the relationship between Joint Vision 2020 and the OMFTS concept. Chapter 2 gave a brief overview of the platforms within the ACE. Chapter 3 created a methodology in which to analyze those platforms in relation to Joint Vision 2020. This chapter has analyzed the current platforms and discussed the projected platforms that will support the neck down strategy envisioned by Commandant Krulak in 1995. The next and final chapter will address all of the preceding information into the four Joint Vision 2020 criteria and show whether or not the ACE can successfully accomplish the OMFTS concept in the twenty first century.

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[1] U.S. Department of the Navy, *Marine Corps Warfighting Publication (MCWP) 3-22 Anti-Air Warfare* (Washington, D.C.: United States Marine Corps, 23 June 2000), 2-1.

[2] "F/A-18 Hornet" available from http://pma265.navair.mil/stores/hornet.html; Internet.

[3] "AIM-9 Sidewinder Missile," available from http://www.chinfo.navy.mil/navpalib/factfile/missiles/wep-side.html; Internet.

[4] "AIM-9X Approved For Low Rate Production," available from http://pma265.navair.navy.mil/reports/2000/001004.html; Internet.

[5] "AIM-120 Advanced Medium-Range, Air-to-Air Missile," available from http://www.chinfo.navy.mil/navpalib/factfile/missiles/wep-amr.html; Internet.

[6] "F/A-18 Hornet," available from http://www.fas.org/man/dod-101/sys/ac/f-18.htm; Internet.

[7] Jacquelyn K Davis and Michael J. Sweeney, *Strategic paradigms 2025: U.S. Security Planning for a New Era* (Dulles, VA.: Brassey's 1999), 175-196.

[8] "AGM-65 Maverick," available from http://www.fas.org/man/dod-101/sys/smart/agm-65.htm; Internet.

[9] "AGM-84 Harpoon SLAM (Stand-Off Land Attack Missile," available from http://www.fas.org/man/dod-101/sys/smart/agm-84.htm; Internet.

[10]"AGM-88 HARM," available from http://www.fas.org/man/dod-101/sys/smart/agm-88.htm; Internet.

[11]"Guided Bomb Unit-10 (GBU-10) Paveway II," available from http://www.fas.org/man/dod-101/sys/smart/gbu-10.htm; Internet.

[12]"Mk82 General Purpose Bomb," available from http://www.fas.org/man/dod-101/sys/dumb/mk82.htm; Internet.

[13]"Harrier II Plus," available from http://www.naval-technology.com/projects/harrier/index.html; Internet.

[14]"AV-8B Harrier," available from http://omen.net.au/~kirou/aircraft/av8b.html; Internet.

[15]"AV-8B Harrier," available from http://www.fas.org/man/dod-101/sys/ac/av-8.htm; Internet.

[16]"AV-8B Harrier II (U.S. Designation)," available from http://www.periscope1.com/demo/weapons/aircraft/attack/w0003089.html; Internet.

[17]"Marine Corps Fixed-Wing Aircraft," available from http://www.hq.navy.mil/airwarfare.html; Internet.

[18]"The AH-1W Cobra Attack Helicopter," available from http://www.cpp.usmc.mil/3dmaw/mag39/hmt303/cobra.htm; Internet.

[19]"AH-1W Super Cobra," available from http://www.inetworld.net/rotorrev/ah1w.htm; Internet.

[20]"Bell Helicopter Textron," available from http://www.bellhelicopter.textron.com; Internet.

[21] Ibid.

[22] Ibid.

[23]"FLIR Systems Awarded Multi-Million Dollar Contract to Supply US Marine Corps with STARFIRE Airborne Systems," available from http://www.flir.spiral8.com/press_releases/pr981027.htm; Internet.

[24]"UH-1N Huey Helicopter," available from http://www.hqmc.usmc.mil/factfile.nsf; Internet.

[25]"NADEP reaches H-46 milestone," available from http://www.nadepcp.navy.mil; Internet.

[26]"CH-53E Super Stallion Helicopter," available from http://www.hqmc.usmc.mil/factfile.nsf; Internet.

[27]"EA-6B Prowler," available from http://www.fas.org/irp/program/collect/ea-6b_prowler.htm; Internet.

[28]Ibid.

[29]"Marine Corps Fixed-Wing Aircraft," available from http://www.hq.navy.mil/airwarfare.html; Internet.

[30]"C-130 Hercules," available from http://www.lockheedmartin.com/factsheets/product8.html; Internet.

[31]"Joint Strike Fighter," available at http://www.boeing.com; Internet. What follows is the mechanics of how the JSF X-32B STOVL engine operates. It shifts to the vertical landing mode by redirecting unaugmented engine thrust downward through nozzles to produce lift. For conventional flight the lift nozzles are closed and thrust flows rearward through the two-dimensional thrust vectoring cruise nozzle to achieve supersonic speeds. On March 8, 2001, Boeing completed engine tests on the X-32B. During these tests the X-32Bs nozzles were successfully redirected from cruise to lift and back to the cruise configuration with a transition time of one to three seconds. These interim ground tests are important because it lays the groundwork for the initial flight of the X-32B, projected to be within the next year.

[32]"Joint Strike Fighter," available at http://www.lmaeronautics.com; Internet. What follows is the mechanics of how the JSF X-35B STOVL engine operates. The four posts are the lift fan (located behind the cockpit), swivel duct and nozzle, and two wing ducts. The lift fan provides most of the thrust, the swivel duct and nozzle controls lift and yaw, and the wing ducts control roll. On February 23, 2001, Lockheed Martin began hover pit engine testing, which is an important milestone to its future first flight scheduled for the end of 2001.

[33]"Joint Strike Fighter," available at http://www.boeing.com; Internet.

[34]"V-22 Osprey," available at http://www.fas.org/man/dod-101/sys/ac/v-22.htm; Internet.

[35]U.S. Department of the Navy, *Marine Corps Doctrinal Publication (MCDP) 1, Warfighting* (Washington, D.C.: United States Marine Corps, 1997).

[36]

CHAPTER 5

THE ACE AND OMFTS: FACT OR FICTION?

> Because of the fluidity of war, some people categorically deny that war plans or policies can be relatively stable, describing such plans or policies as mechanical. This view is wrong . . . because the circumstances of war are only relatively certain and the flow (movement or change) of war is rapid, war plans or policies can be only relatively stable and have to be changed or revised in good time in accordance with changing circumstances and the flow of war; otherwise we would become machinists. But one must not deny the need for war plans or policies that are relatively stable over given periods; to negate this is to negate everything, including the war itself as well as the negator himself.
>
> Mao Tse-tung, *Selected Military Writings*

A direct correlation can be drawn between the fluidity of war, plans and policies, and the evolution of military warfare. These things are only relatively certain. Throughout the evolution of military warfare one cannot predict technological advances, ideological transformations, cultural shifts, or changing domestic or foreign interests. What can be relatively certain is that as a nation state evolves and expands, friction with other nation states will inherently cause conflict. A nation state has to be prepared for this conflict. Whether its approach to this conflict is mechanical or flexible will determine its success or failure. It may conduct warfighting exercises to test its concepts or approach to conflict, but the ultimate validation will occur in its first battle.

As described in chapter 1, the Marine Corps amphibious doctrine, since its inception in the early twentieth century, has developed a flexible approach to conflict. Furthermore, this flexible approach has brought the Marine Corps to its current concept, *Operational Maneuver from the Sea*. Chapter 2 described the components of the MAGTF, the six functional areas of Marine aviation, and the mission capabilities of the ACE. Chapter 3 identified the relationship between Joint Vision 2020 and the OMFTS concept and developed a methodology to analyze this relationship. Chapter 4 analyzed the current and projected platforms and their ability to accomplish the OMFTS concept in the twenty first century. This chapter will answer the question: The ACE and OMFTS in the twenty first century, fact or fiction?

The ACE's ability to successfully accomplish the OMFTS concept is based upon the answers to three questions. Is the ACE able to become the integral maneuver element to successfully accomplish the four operational concepts that are embedded in Joint Vision 2020 and the OMFTS concept? Is there a shortfall between the current and projected employment of aviation assets in the accomplishment of the OMFTS concept? Are the current and projected platforms the right choice for the OMFTS concept?

The first question to be answered: Is the ACE able to become the integral maneuver element? From the analysis conducted in chapter Four the answer to that question is yes, but with stipulations. The ACE currently has the platforms that can successfully conduct OMFTS operations in support of the MAGTF; however, two platforms are struggling to meet the OMFTS concept. These two platforms are the AV-8B and the CH-46E. The AV-8B has recently been removed from the Amphibious Ready Group (ARG) deployment schedule. This removal was a result of recurring

maintenance issues, which ultimately led to a severe lack of pilot proficiency. The AV-8B is expected to re-deploy with the ARG once the Marine Corps has repaired its fleet of aircraft and regained pilot proficiency. But the absence of the AV-8B leaves a gap in the MAGTF combined arms mission, which is paramount for the success of the OMFTS mission.

On the other side of the spectrum, the CH-46E has served Marine Corps aviation for over thirty years. Ironically, it was initially developed for the Marine Corps as an interim solution during the Vietnam War. The CH-46E is fast approaching the end if its useful capabilities. Numerous upgrades in the 1980s and 1990s have significantly reduced its original operating capabilities as developed in the late 1960s. It does not currently have the range and speed to successfully accomplish the concepts as described in the OMFTS concept. It is in need of a replacement that can generate the tempo and momentum needed for the OMFTS concept in the twenty first century.

The second question asks: Is there a shortfall between the current and projected employment of aviation assets in relation to the OMFTS concept? The answer to this question is yes; however, there is a very fine line separating yes and no. The projected replacement for the CH-46E is the MV-22 tilt-rotor aircraft. The MV-22 is a technological leap in amphibious warfare, much like the initial use of the helicopter was during the Korean War. It best suits the needs of the OMFTS concept. It can conduct OTH operations farther, faster, and with an increased load carrying capacity. Recently, the MV-22 has suffered mishaps during the end of its operational testing phase. These unfortunate incidents have delayed the initial operating implementation by an undeterminable amount. This delay creates a shortfall for the replacement of the CH-46E.

An analogy can be used to describe the same initial delays to that of the F-14. Two decades ago, the Navy's initial operational testing of the F-14 also came under scrutiny. The F-14 had suffered numerous mishaps during its testing and initial implementation phases. Yet, now it is the premier fleet defense aircraft for the Navy. Opponents of the MV-22 need to realize that the capability of the MV-22 far exceeds those of the CH-46E, and is a vital link to the successful accomplishment of the OMFTS concept. The MV-22 is part of a triad of platforms that is an absolute requirement for the OMFTS concept. The other two platforms are the AAAV and the LCAC. These two platforms are not aviation related, and were not discussed in this thesis. The Department of Defense has convened an operational feasibility board to decide whether or not the MV-22 is a viable option to replace the CH-46E. Additionally, the upcoming Quadrennial Defense Review will decide the fate of the MV-22, as well as the JSF.

The F/A-18 and AV-8B do have shortfalls that may make the OMFTS concept difficult to implement in the twenty first century. Two shortfalls of the F/A-18 are that it lacks a V/STOL capability and is slowly reaching its limit in upgrade ability to meet emerging technology. The AV-8B has the expeditionary capability, however, it is experiencing increasing maintenance issues which not only affect operational deployments but pilot proficiency as well. It is at this point that the JSF plays an important role in the OMFTS concept. Not only will the JSF be able to meet emerging technology for years to come, but will also be four times as lethal as the current operational ACE tactical platforms. Additionally, it will incorporate a low signature to enhance its survivability. Logistically, it will have a commonality of 70 to 90 percent and utilize the COTS process to significantly reduce its operating costs. These

advantages alone make the JSF a priority to successfully accomplish the OMFTS concept in the twenty first century; however, if the JSF program is delayed or cancelled, a significant shortfall in the accomplishment of the OMFTS mission will occur.

The third question raised: Are the current and projected platforms the right choice for the OMFTS concept? In order to answer this question, the correlation between the OMFTS concept and the criteria of Joint Vision 2020, as analyzed by the methodology that was developed in chapter Three, has to be discussed. One criterion of Joint Vision 2020 seems to best fit the OMFTS concept, which is precision engagement. Precision engagement fully supports the principal tenants of the OMFTS concept. It delivers troops straight to the objective; generates overwhelming tempo and momentum; pits strength against weakness; and emphasizes intelligence, deception, and flexibility. This is not to say that dominant maneuver, full dimensional protection, and focused logistics of Joint Vision 2020 are not vital; however, they do not play as vital a role as precision engagement.

Within precision engagement the ACE has to be able to focus on the operational objective. When conducting the OMFTS concept the MAGTF will utilize the sea as a maneuver space in conjunction with an OTH launch capability. If the objective is 100 NM or farther inland, the ACE will need platforms that can reach those objectives with the ability to generate overwhelming tempo and momentum. The MV-22 is the only viable option for this requirement. Its tilt-rotor technology allows it to fly farther and faster, which generates the overwhelming tempo and momentum sought by the MAGTF. The upgraded AH-1Z and UH-1Y will significantly increase the speed, range, maneuverability, lift, and logistical support capabilities of the ACE. Additionally,

tactical ACE platforms will have to utilize their capabilities to gather intelligence, conduct deception, and have the flexibility to pit their strengths against the enemy's weakness, in support of the GCE.

The F/A-18, EA-6B, AV-8B, and the AH-1W all give the MAGTF the flexibility, maneuverability, and lethality to support the GCE in attaining the OMFTS objective. The F/A-18 has the multi-mission capability and lethality to attack the enemy where they are weakest and facilitates the criterion of dominant maneuver in support of Joint Vision 2020 and the OMFTS concept. The EA-6B provides the DOD and MAGTF with the only full time EW capability. The AV-8B and the AH-1W contribute not only to those capabilities mentioned above, but also support the V/STOL vision as described by Commandant Greene in 1965 and Commandant Krulak in 1995. The ability to have a V/STOL capability is imperative in the OMFTS concept. In conflicts in the future, traditional prepared surfaces may not be available, and the only ability to combat the conflict may come from the sea, which is what makes the OMFTS concept a viable one in the twenty first century. Operations conducted from OTH straight to the objective will not allow for an expeditionary airfield. Therefore, it is imperative that all ACE platforms have a V/STOL capability. Once the JSF and the MV-22 are incorporated into the ACE, the MAGTF will be able to successfully accomplish the OMFTS mission in the twenty first century.

Even though precision engagement is at the forefront of the OMFTS concept, dominant maneuver, full dimensional protection, and focused logistics are needed to augment precision engagement. Dominant maneuver is the ability to gain control of the entire spectrum of the battle space. This means that the naval expeditionary force must

gain land, air and sea superiority. Land superiority will only be gained after the OMFTS objectives have been attained, while naval forces will achieve sea superiority. Therefore, air superiority falls upon the ACE. The F/A-18 and the AV-8 have the flexibility, maneuverability and lethality to achieve air superiority. The AH-1W does have a limited A/A capability to augment both the F/A-18 and the AV-8. However, the JSF which is scheduled to replace both the F/A-18 and the AV-8 in the 2010 timeframe will significantly enhance the ability of the ACE to support the criterion of dominant maneuver in support of Joint Vision 2020 and OMFTS in the twenty first century.

Full dimensional protection is the conservation of the operational fighting force. Most of full dimensional protection will rely on conducting OTH operations, giving the naval expeditionary the ability to utilize the sea as a barrier to the enemy. As mentioned in chapter Four, the primary platform in full dimensional protection is the EA-6B. However, the EA-6B is a national DOD asset, and at times may not be available to the MAGTF. Therefore, it is imperative that an EW variant of the JSF be developed that will give the ACE the ability to augment full dimensional protection.

Focused logistics is the final criterion that has been analyzed in this thesis. It is achieved by the fusion of information, logistics, and transportation technologies to provide rapid crisis response; track and shift assets even while enroute, and deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical levels of operation. The CH-53E is the primary workhorse for logistical sustainment of the forces at the OMFTS objective; however, once operations shift to sustained operations ashore, the KC-130 becomes the primary support platform by virtue of its increased range and load carrying capacity. For the OMFTS concept; however, the

CH-53E is the platform that is required. The CH-53E is projected to serve the MAGTF until the 2025 timeframe. Since a traditional developmental cycle of incorporating a new platform into the fleet is between 15 to 17 years, a concept for a replacement needs to be on the drawing boards now, possibly a more robust variant of the MV-22.

With the Navy Strategic Planning guidance stating that there will be no peer competitor until the 2020 timeframe, now is the time to evaluate the OMFTS concept, not only in aviation but other realms as well. What happens to the ACE if the JSF and the MV-22 are not implemented? Can the MAGTF conduct the OMFTS concept with just a helicopter force? Is it feasible to do away with the Marine Corps F/A-18 in carrier operations, and employ just the AV-8B or JSF from amphibious ships? These are a few questions worthy of future studies.

The Marine Corps is conducting warfighting exercises to evaluate the ability of a concept such as OMFTS. However, as history has shown, this concept can only truly be evaluated in a first battle. The ACE must be prepared. The ACE and OMFTS: fact or fiction? If the MV-22 and JSF are integrated into the ACE, it is a fact that the MAGTF will be able to successfully conduct OMFTS. However, if these platforms are cancelled, the implementation of the OMFTS concept becomes fiction.

Aircraft Capabilities Guide

CH-46E

Dimensions

Height ....16 feet 8 inches
Weight...........................16,5000 pounds (empty)
24,300 pounds (maximum gross weight)
Rotor Diameter..51 feet
Length ....84 feet 4 inches

Airspeed

Maximum endurance .... 70 KIAS
Maximum range........................ 110 to 130 KIAS
Maximum airspeed .... 145 KIAS

Fuel Capacity

Pounds..4,488
Gallons...660

Endurance

Payloads.. 4,300 pounds
18 pax
Endurance ....2 + 55 hours

Weapons Systems

Guns.................................2 X 50 caliber XM 218

Other Systems

GPS navigation .... Miniature Airborne GPS Receiver (MAGR) System (Communications/Navigation Control System [CNCS] configured A/C only)

Communications Equipment

HF... 1 X AN/ARC-94
VHF/UHF.............. 1 X AN/ARC-182 w/KY-58 encryption device
UHF.............. .... 1 X AN/ARC-51A w/KY-58 encryption device
VHF/UHF.............. 1 X AN/ARC-210 w/KY-58 encryption device (CNCS configured A/C only)

Aircraft Survivability Equipment

RWR...................AN/APR-39(V)1 radar warning receiver
IRCW.................. AN/ALQ-157 infrared jammer
Expendables..........AN/ALE-39 countermeasures dispenser
Missile warning................... AN/AAR-47 missile warning system

CH-53D

Dimensions

Height.. 24 feet 11 inches
Empty weight .... 27,000 pounds
Rotor diameter.... .... 72 feet 3 inches
Length .... 88 feet 6 inches
Maximum gross weight................ 42,000 pounds

Airspeed

Maximum endurance............................ 70 KIAS
Maximum airspeed............................. 130 KIAS

Fuel Capacity

Pounds............……………………...........13,178
Gallons 1,938

Endurance

Payload...37 pax
8,000 pounds internal
Typical .... 3 + 00 hours
Best case.. 5 + 30 hours

Weapons Systems

Guns .... 2 X 50 caliber XM 218

Other Systems

None

Communications Equipment

HF................. 1 X AN/ARC-94 or AN/ARC-174
UHF/VHF............... 2 X AN/ARC-182 w/KY-58 encryption device or 2 X AN/ARC-210 w/KY-58 encryption device

Aircraft Survivability Equipment

RWR.........AN/APR-39(V)1 radar warning receiver
IRCM AN/ALQ-157
Missile warning…………... AN/AAR-47 missile warning system

CH-53E

Dimensions

Height .... 28 feet 4 inches
Empty weight ....36,000 pounds
Rotor diameter... 79 feet
Length... 99 feet 1/2 inch
Maximum gross weight.................73,500 pounds

Airspeed

Maximum endurance............................... 5 KIAS
Maximum airspeed............................. 150 KIAS

Fuel Capacity

Pounds 15,000
Gallons 2,277

Endurance

Payload .... 37 to 55 pax
20,000 pounds internal
Typical... 4 + 00 hours
Best case .... Indefinite with AR

Weapons Systems

Same as CH-53D

Other Systems

FLIR AN/AAQ-16B

Communications Equipment

Same as CH-53D

Aircraft Survivability Equipment

RWR... same as CH-53D
IRCM.. none
Missile warning .... same as CH-53D

Dimensions

Height .... 13 feet 1 inch
Weight..........................….. 6,900 pounds (empty)
10,5000 pounds (maximum gross weight)
Rotor diameter ....48 feet
Length ....57 feet 4 inches
Fuselage width ....9 feet 4.5 inches

Airspeed

Maximum endurance .... 55 to 65 KIAS
Maximum airspeed .... 130 KIAS

Fuel Capacity

Pounds............ 1,329.5 internal; 1,020 additional w/auxiliary fuel cells (2 maximum)
Gallons........... 195.5; 150 additional w/auxiliary fuel cells (2 maximum)

Endurance

Best case .... 1 + 30 (internal fuel only; 1,300 pounds gear/ordnance/pax)
2 + 20 (1/2 auxiliary fuel cell; 900 pounds gear/ordnance/pax)
3 + 10 (full auxiliary fuel cell; 400 pounds gear/ordnance/pax)
Worst case.................. 1 + 15 (internal fuel only; 1,300 pounds gear/ordnance/pax)
2 + 00 (1/2 auxiliary fuel cell; 900 pounds gear/ordnance/pax)
2 + 45 (full auxiliary fuel cell; 400 pounds gear/ordnance/pax)

Weapons Systems

Guns..7.62mm M2A0E
7.62mm GAU-17
50 caliber GAU-16
Rockets ....2.75 inch rockets, WAFFAR
Typical mix: CAS ....(14) 2.75 inch rockets, GAU-16/GAU-17

Other Systems

GPS navigation .... Doppler GPS Navigation System (CDNU configured A/C only)
FLIR........... AN/AAQ-22 Navigation FLIR with LASER range finder and VCR
Miscellaneous .... loudspeaker for PSYOPS missions; AN/ULQ communications jamming package

Communications Equipment

VHF/UHF .... 3 X AN/ARC-210 w/KY-58 encryption device
(SATCOM available on one radio only)
UHF....................... 1 X AN/ARC-182 w/KY-58 encryption device
UHF....................... 1 X AN/ARC-159 w/KY-58 encryption device
VHF....................... 1 X AN/ARC-114 w/KY-58 encryption device
Miscellaneous .... ASC-26 communication package provides 1 X UHF and 2 X VHF radios for airborne command and control

Aircraft Survivability Equipment

RWR .... AN/APR-39 radar warning receiver
AN/APR-44 CW radar warning receiver
IRCM AN/ALQ-144
Expendables ....AN/ALE-39 countermeasures dispenser
Missile warning.................. AN/AAR-47 missile warning system
Laser warning.................................. AN/AVR-2

AH-1W

Dimensions

Height.. 13 feet 9 inches
Weight........................... 10,5000 pounds (empty)
14,750 pounds (maximum gross weight)
Rotor diameter... 48 feet
Length .... 58 feet
Fuselage width .... 3 feet 7 inches

Airspeed

Maximum endurance............................. 72 KIAS
Maximum speed................................... 190 KIAS
170 KIAS (w/wing stores)

Fuel Capacity

Pounds... 2,037
Gallons 304

Endurance

Payload.............2,250 pounds (in addition to full internal fuel)
Typical .... 2.3 hours
Best case.. 2.6 hours
4.6 hours (with 2 auxiliary fuel tanks)
Worst case .... 1.8 hours
3.6 hours (with 2 auxiliary fuel tanks)

Weapons Systems

Missiles ....BGM-71 A/A-1/C/D/E/E-5B TOW
AGM-114A/B/C/K Hellfire
AGM-122A Sidearm
AIM-9L/M Sidewinder
Guns .... 20mm turret (+110 AZM, +30 elevation -50°)
20mm ammo (MK 50 series, PGU 27/28/31 series)
Rockets................. LAU-61/68 2.75 inch rockets, 7 or 19 shot pod
LAU-10, 5 inch rocket, 4 shot pod
Typical mix:
AAW .... 2 X AIM-9, 2.75 inch flechette, 20mm gun
OAS..................... Hellfire, TOW, 5 inch rockets, internal gun
Armed RECCE.............Hellfire, TOW, 2.75 inch rockets, internal gun (Sidearm)
Escort....................Sidewinder, 2.75 inch RP/HE, internal gun, TOW/Hellfire
FAC(A)................. Hellfire, TOW, 2.75 inch RP, internal gun

Other Systems

GPS navigation................... Embedded GPS/INS (1686 upgrade)
FLIR ....Night Targeting System
Laser ....Pulsed, 1064 nm, neodymiun: YAG; laser designator and ranging system
CCTV .... TV camera
VCR.......... SVHS and VHS recording capability
Optics .... Direct view optics

Communications Equipment

VHF/UHF................2 X AN/ARC-182 w/KY-58 encryption device
VHF/UHF................2 X AN/ARC-210 w/KY-58 encryption device (1686 upgrade only)

Aircraft Survivability Equipment

RWR.................. AN/APR-39V(1) radar warning receiver (pulsed)
AN/APR-44 radar warning receiver (CW)
IRCM..AN/ALQ-144
Expendables .... AN/ALE-39 countermeasures dispenser

Models..................... AV-8B Day Attack (DMT);
AV-8B Night Attack (NVD/FLIR);
AV-8B II + RADAR

Dimensions

Height ....11 feet 8 inches
Weight................................4,600 pounds (empty)
39,000 pounds mixed gross weight
Wingspan ....30 feet 3 inches

Airspeed

Maximum endurance .... 230 KIAS
Maximum airspeed .... 585 KCAS/1.0 IMN

Fuel Capacity

Pounds...7,759 internal
11,749 with 2 external drop tanks
830 with 4 external drop tanks

Endurance..................... Varies significantly with
ordnance load and mission profile.
Refer to NWP 3-22.5-AV8B,
Vol I for specific weapons
load profiles

Hi Lo Hi profile with
6 Mk 82, DECM, and
gun .... Combat radius 170 nm
loiter time 25 minutes

Lo Lo Lo profile with
6 Mk 82, DECM, and
gun .... Combat radius 80 nm
loiter time 15 minutes

Weapons Systems

Guns .... GAU-12 25mm gun
Rockets........................ 2.75 and 5 inch HE-Frag,
AT/APERS
HEGP, WP, RP, ILLUM, and chaff
Bombs .... Mk 81, Mk 82, Mk 83
Mk 20 Rockeye, MK 77 Napalm
GBU-12, GBU-16 LGB
CBU-72 FAE, CBU-78 Gator
Missiles .... AGM-65E Laser Maverick
AGM-65F IR Maverick
(night attack only)
AGM-122 Sidearm
AIM-9 Sidewinder
Miscellaneous .... LUU-2A/B Illuminum flares,
Mk 58 Marine Location Marker

Other Systems

GPS navigation .... Integrated P-coded GPS
targeting system
FLIR............................ 1 power navigation FLIR
Dual mode tracker.......... laser spot tracker with 6
power TV video
Camera .... VTR HUD/dual-mode tracker
recorder

Communications Equipment

VHF/UHF .... 2 X RT-1250A/ARC with
KY-58 encryption device

Aircraft Survivability Equipment

RWR .... AN/ALR-67 radar warning receiver
DECM................... AN/ALQ-164 DECM system
Expendables ....AN/ALE-39 countermeasures
dispenser

F/A-18 (Models A/C/D)

Dimensions

Height.. 15 feet 3 inches
Weight............................. 24,500 pounds (empty)
51,900 pounds (maximum T/O)
Wingspan .... 40 feet 5 inches

Airspeed

Maximum endurance........................... 250 KIAS
(approximate)
Maximum airspeed........... 750 KIAS (NATOPS)
650 KIAS (sea level)

Fuel Capacity

Pounds........................... 12,800 (10,800 internal,
2,000 centerline tank)
Gallons .... 1,900 (1,500 internal,
400 centerline tank)

Endurance

Typical .... 1 + 30 hours
Best case... 2 + 45 hours
Worst case ....12 minutes
Hi Hi Hi profile with
centerline tank .... 2 + 45 hours

Weapons Systems

Guns .... 20mm internal gun
Rockets..........................LAU-10 (5 inch rockets)
LAU-51 (2.75 inch rockets)
LAU-61 (2.75 (2.75 inch rockets)
Radar .... APG-65 multimode radar
Missiles .... AGM-65E Laser Maverick
AGM-65F IR Maverick
AGM-88 Harm
Walleye I/II
AIM-7 Sparrow
AIM-9 Sidewinder

Bombs.. Mk 80 series
Mk 20 Rockeye, GBU-10/12/16
CBU-59 APAM
CBU-78 Gator, Mk 77 Napalm
Mk 36, Mk 40, Mk 4
(Destructors)
Mk 52, Mk 55, Mk 56
(Bottom/Moored Mines)
Mk 62, Mk 63, Mk 64, Mk 65
(Quickstrike Mines)
Miscellaneous............. Tactical air-launch decoy

Typical mix:
Air-to-air........................ 2 AIM-9, 2 to 4 AIM-7,
6 second 20mm
Air-to-ground .....……………… 4 to 8 Mk 82 or
2 to 4 Mk 83
2 AIM-9, 2 AIM-7

Other Systems

FLIR .... AN/AAS-38 target FLIR
AN/AAR-50 navigation FLIR
(F/A-18C/D only
Laser .... AN/AS-1 73 laser spot tracker
On-board recording .... HUD recorder,
DDI selectable
AN/ASQ-1 73 35mm strike camera

Communications Equipment

VHF/UHF...............2 X AN/ARC-182 w/KY-58
encryption device

Aircraft Survivability Equipment

RWR............AN/ALR-67 radar warning receiver
DECM .... 2 X ALQ-126B
AN/ALQ-167 (tactical contingency pod)
Expendables .... AN/ALE-39 countermeasures
dispenser

EA-6B

Dimensions

Height ....16 feet 8 inches
Weight..............................34,000 pounds (empty)
61,500 pounds (maximum T/O)
Wingspan ....53 feet

Airspeed

Maximum endurance .... 53 to .55 IMN, aircraft configuration dependent
Maximum airspeed .... 86 IMN (TJS pod limitation)
Minimum airspeed ....114 KIAS (minimum approach speed)
220 KIAS (TJS pod operation)

Fuel Capacity

Pounds...........….... 25,400 total; 15,400 internal, 10,000 external
Gallons....................... 3,768 total; 2,268 internal, 1,500 external

Endurance……Varies greatly depending on aircraft configuration and mission profile; typical pod and external fuel load will result in approximately 1 hour and 45 minutes loiter without AR
Hi Lo Lo Hi profile with
4 X TJS pods.................... 425 nm mission radius

Weapons Systems

Jammers ……............. 5 X AN/ALQ-99 tactical jamming pods
Radars ..…. AN/APS-130 ground mapping radar
Missiles .... AGM-88 HARM
Miscellaneous .... AN/ALE-41 and 43 corridor chaff pod
AN/ALQ-99 on-board receiver system
Typical mix: .... Load based on enemy order of battle and threat; typical load will be 3 to 4 tactical jamming pods, 1 to 2 AGM-88 or external fuel tanks

Other Systems

On-board recording......... AN/ALQ-99 on-board/ tactical jamming system recorder
Miscellaneous .... UHF/VHF, AM/FM regency scanner
USQ-113 Communications jammer

Communications Equipment

HF .... 1 X AN/ARC-105
VHF.. 1 X AN/ARC-175
UHF........................ 2 X AN/ARC-159 w/KY-58 encryption devices

Aircraft Survivability Equipment

RWR .... None
DECM........... 2 X ALQ-167 tactical contingency pod (training only)
Expendables ....AN/ALE-39 countermeasures dispenser

KC-130 (Models F/R/T)

Dimensions

Height.. 38 feet 4 inches
Weight............................ 90,000 pounds (empty)
Maximum gross weight .155,000 pounds (SLEP)
135,000 pounds (non-SLEP)
Length .... 97 feet 9 inches
Wingspan .... 132 feet 7 inches

Airspeed

Maximum endurance .... 240 KIAS
Maximum airspeed .... 350 KIAS

Fuel Capacity

Takeoff fuel KC-130F …………….41,406 cargo
65,831 tanker
KC-130R/T ....59,606 cargo
84,032 tanker

Endurance

Typical ....13 hours

Aircraft Survivability Equipment

ALQ-157, AAR-47
ALE-139, APR-39*
Night vision lighting*
*Only specially configured aircraft

Air Delivery of Cargo and Personnel

Container delivery system ...... Up to 16 bundles; 37,248 pounds
Military free fall................. ....64 jumpers
Heavy equipment ....Vehicles, ammo, cargo (42,000 pounds)
Personnel staticline ....64 jumpers

Short Unimproved Airfield Operations

Size and strength of runway are performance/ weight dependent. Standard is 3,500 feet by 60 feet.

Mission Profiles

DASC(A) capable, radio relay, battlefield illumination

Rapid Ground Refueling Flow Rates
(pounds per minute)

Model	Point	IFR drogue panel	SPR Pod
AH-1W	1	59	34	49
	2	54	29	44
CH-46	1	79	44	59
	2	69	35	49
CH-53	1	66	40	56
	2	56	31	46

Communications Equipment

VHF/VOR.................................. 2 X AN/AR126
UHF................................ 2 X AN/ARC-159(V)1
HF.. 2 X AN/ARC-190
SATCOM*
DASC suite.................................... AN/UYQ-3A
*Some aircraft are configured to operate these systems

Other Systems

Radar..... AN/APS 133 (weather, ground, beacon IFF capable) INS, GPS*
Celestial Navigation*
*Some aircraft are configured to operate these systems

Air Land Delivery of Cargo and Personnel
Cargo-configured Airframe

Passengers	Pallets	Troops
0	6	0
92	1	76
72	2	44
52	3	33
41	4	32
24	5	16

70 litters with 6 attendants
74 litters with 2 attendants

Tanker-configured Airframe

Passengers	Pallets
40	1
24	2

Aerial Refueling Transfer Rates
(JP-5 at Standard Daytime Temperature)

	1 receiver (pounds per minute)	2 receivers (pounds per minute)
F cargo	980	490
R or T cargo	1,020	510
F tanker	2,040	2,040
R or T tanker	2,040	2,040

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